

Make your arrangements now to attend the Annual Meeting of the Central Association of Science and Mathematics Teachers at Chicago, November 24 and 25, 1944.

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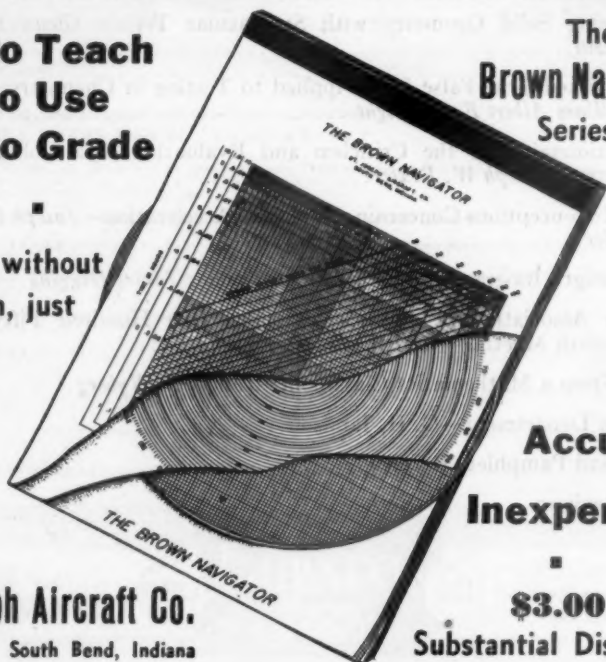
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SCHOOL SCIENCE AND MATHEMATICS

VOL. XLIV

OCTOBER, 1944

WHOLE NO. 387

The Central Association of Science and Mathematics
Teachers

POST WAR PLANNING

The Forty-fourth Annual Convention of the Central Association of Science and Mathematics Teachers will be held at The Stevens Hotel in Chicago, Illinois on Friday and Saturday, November 24 and 25. For the third successive year we are meeting under conditions which are not conducive to good attendance but, in consideration of the many serious problems confronting education in the post-war era, science and mathematics teachers should put forth every effort to get together to discuss these problems.

The war emergency has forced us, as science and mathematics teachers, to evaluate our capabilities and our deficiencies. We were handed a job to do in pre-induction training and the Army Service Forces are very liberal in their praise of the speed with which we got the program under way and of the excellent results achieved in the whole program. We realize more than ever before the necessity for seeing that every child is given the opportunity to receive science and mathematics instruction to meet the needs for a better way of life. Many of our boys and girls who are in the service of our country have come back on furlough and have told us of the importance of good basic training in science and mathematics.

We have watched the rapid developments during the war and can see the many implications in our post war living and are all looking forward to the problems of teaching in our various

subject matter fields in the years to come. Thus it is appropriate that we get together to hear prominent educators and authorities in the specialized fields express their opinions on "Post War Planning." The convention will open Friday morning with the keynote address by Col. W. E. Watters, Chief, Special Training Branch, Army Service Forces, Washington, D. C. Col. Watters will talk on the Role of Pre-Induction Courses in Post War Planning. He will be followed by Dr. Harl R. Douglass, Director, College of Education, University of Colorado, Boulder, Colorado whose subject will be "Some Important Considerations in Adapting Science and Mathematics Instruction to Post War Needs and Conditions." Dr. Frederick F. Yonkman, Chief Pharmacologist, Ciba Pharmaceutical Co., Summit, New Jersey will close the morning session with a most interesting lecture on "Those Drugs of Ours." A demonstration lecture on "Power for War" by Mr. C. M. Ripley, General Electric Company, Schenectady, New York will be the feature of the Annual Luncheon on Friday noon. The Saturday morning General Session will be addressed by Mr. Louis Bromfield, Malabar Farm, Lucas, Ohio on the Subject of Conservation.

The section and group chairmen have done an excellent job in arranging their programs for Friday afternoon and Saturday morning. A few of the prominent speakers which these chairmen have obtained for their programs are: Dr. Don C. Rogers, Assistant Superintendent, Chicago Public Schools; Dr. Robert Havighurst, University of Chicago; Dr. Raleigh Schorling, University of Michigan; Dr. Maurice Hartung, University of Chicago; Dr. J. S. Richardson, Miami University; Mr. Nathan Neal, Cleveland Public Schools; Dr. Jonathan Forman, Columbus, Ohio; Dr. Gustave Egloff, Cleveland, Ohio; Dr. Walter H. Carnahan, Purdue University; Miss Edith P. Parker, University of Chicago; Mr. William Gregory, Western Reserve University; Miss Rose Lammel, Ohio State University.

All members of the Association should make plans now to attend the 1944 Convention. With the problems ahead and the need for all science and mathematics teachers to have a part in solving these problems it is hoped that non-members will take advantage of the opportunities offered by attendance at the Convention. Guest convention tickets will be available for non-members for the small sum of fifty cents. Holders of these tickets will be able to attend all convention meetings. Because of war-time conditions it is important that travel and hotel reservations be made soon.

The Association Yearbook containing the complete Convention Programs will be mailed to members in October. Non-members may receive complimentary copies of the Yearbook by writing the Editor, Professor J. E. Potzger, Butler University, Indianapolis 7, Indiana.

EMIL L. MASSEY, *President*

MATTHIAS JACOB WASHINGTON PHILLIPS

Near the close of last school year death again entered our ranks and took one of our most beloved and active members. M. J. W. Phillips, head of the science department of West Allis, Wisconsin, High School, a teacher in the summer session at Marquette University, a former treasurer of the Central Association, and a contributor of many practical articles died June 3, 1944. His active support of this Journal and of the Central Association cannot be replaced but for the school and community of West Allis his death was still a greater loss.

Mr. Phillips was born February 22, 1888, at New Berlin, Wisconsin. He attended the country school, Carroll Academy and Carroll College, receiving the Bachelor of Arts degree in 1910. He taught at Mellen and River Falls before entering West Allis in 1913. He did graduate work at the University of Chicago and at Marquette University. The Master of Education degree was conferred posthumously by the latter school in June of this year. In 1927 Mr. Phillips was awarded the Sachs prize by Columbia University, which carried with it an award of \$1,000, for outstanding contributions to science teaching in the secondary schools. Last spring he was elected a member of the Science Masters Association of England. Near West Allis he donated a tract of land to the Milwaukee Astronomical Society for the construction of its observatory. He was a prominent member of the Masonic order and took an active part in civic affairs, frequently giving lectures to the Lions Club, Rotarians, Kiwanas, and groups of young people. In his school work he was eminently successful in directing original activities of his science students. His laboratory was an unusual attraction for visiting science teachers but was most useful in influencing the thought and future life of his students.

In 1913 at Chicago he was married to Miss Audra Knickerbocker, who survives him. At the death of Mr. W. F. Roecker

two years ago Mr. Phillips took over the work of the treasurer of the Central Association and assisted the business manager of the journal for which he refused compensation. The following is a part of the Eulogy delivered at the funeral by the Rev. Harold E. Wagner of St. Peters Episcopal Church of West Allis:

"We stand in the presence of such a life this evening. A life lived in service for others. A life to whom not only the young people have looked for inspiration and guidance and advice, but also the entire community. For thirty-one years he has been faithful in his service here. Countless young men and women have sat at his feet and had the mysteries of science unfolded for them, and thus have had their horizons enlarged and their minds broadened. The high regard in which he is held not only by those who have been instructed by him, but also by the entire community, is evidenced by those of you who are here this evening to pay him your last respects.

"Mr. Phillip's life should be a challenge to all of us. He refused to quit. Warned some weeks ago that he should take a complete rest, his high sense of duty and responsibility would not permit this, and he kept up his usual routine because he did not wish to alarm his family or friends. We stand, therefore, in the presence of one who was a soldier, a soldier on the home-front, and he is as much a hero as those on our battle fronts this evening. Truly it can be said of him in his citation in the Book of Life, 'Died of wounds received in the line of duty' . . .

"Thus it is that we bid him farewell, as we see him with firm and resolute step in his usual cheery and infectious manner, a joke on his lips, a twinkle in his eyes, and a smile on his face, going on and ever on gradually fading from our sight as he enters the Valley of the Shadows from which there is no return. And so we bid him farewell."

GLEN W. WARNER
PAULINE ROYT

CHARLES A. STONE

In August death took another of our leaders in the field of mathematics education. Professor Charles A. Stone of De Paul University, and our junior mathematics editor, died August 14 at his home in Chicago. An account of his life and educational work will be published in November.

A NEW EDITOR FOR THE DEPARTMENT OF PHYSICS RESEARCH

Professor Joseph D. Elder now replaces Professor Duane Roller as editor of the Research Department in physics. Both Professor Roller and Professor Elder are now located at Wabash College, Crawfordsville, Indiana, and are Editor and Assistant Editor respectively of the *American Journal of Physics*. Mr. Elder received the A.B. and A.M. degrees from Princeton University and has done additional graduate work at Princeton and Columbia. He taught at the University of Vermont, Haverford College, and Lynchburg College before taking up his present position at Wabash College. For the past two years he has been at Washington as Consultant to the National Defense Research Committee engaged in technical editorial work on reports for the Division of Armor and Ordinance. Since coming to Wabash College last March he has continued the work previously begun at the request of the Navy of editing, in collaboration with Dr. Roller, a translation of Cranz's *Lehrbuch der Ballistik*. His work as an associate editor of the famous book on "Demonstrations Experiments in Physics" published in 1938 under the auspices of the *American Journal of Physics* is known to all physics teachers.

TO AMERICAN TEACHERS AND SCHOOL ADMINISTRATORS

During the past school year American boys and girls under your guidance have saved over \$510,000,000 through War Bonds and Stamps purchased in school. At the same time, they have developed strong habits of thrift, an increased sense of civic responsibility, and knowledge of war finance.

More than this, the schools have gone into the community to explain the significance of the national war finance program. Now the Treasury recognizes that the schools are assuming a major assignment—that of sustaining community enthusiasm for continuing War Bond participation between drives.

Your leadership and untiring efforts have made the Schools-at-War Program a constructive force in the war effort. During the momentous months ahead, the example set by your students through their weekly saving and self-denial will be an inspiration to all the rest of us.

Sincerely yours,

H. Morgenthau, Jr.
Secretary of the Treasury

THE RELATIONSHIP OF MATHEMATICS AND GEOGRAPHY

EDWARD E. KESO
University of Missouri

Geography may be defined as the study of man in his relationship to the physical, social, and economic environment of the world. In this respect a study of geography is not only necessary for an understanding of other subjects, but is likewise dependent upon various other subjects for information that geography itself may be better understood.

The present World War, with its global aspects, has focused attention upon subjects that are not only necessary to the winning of the war, but also necessary for an understanding of the world and world conditions in times of peace. Two of these subjects, namely, geography and mathematics, seem to have been neglected so much before the war that our soldiers were found deficient in them, and a study of these subjects was included in practically all of the educational programs sponsored by the military departments of our country.

A workable knowledge of mathematics has always been needed and desirable for an understanding of geography. With modern applications of geography to the globular idea of thinking this is becoming more evident each day. Geography instruction will no doubt be stressed more in the future. The relation of mathematics to geography not only needs to be taught, but also may serve to motivate the study of both subjects.

Many of our ancient geographers were also mathematicians or astronomers. This is especially true of the cartographers. Geometry is believed to have originated because of the need of the ancient Egyptians for a definite systematic method of surveying and relocating the land of the Nile valley after familiar boundaries were obliterated by floods.

The major part of *The Universal Geography*, edited by Isaak Newton in 1672, deals with mathematical geography; and a preliminary chapter on geometry and trigonometry was included to give the student the needed mathematical basis to an understanding of the study.

It may be inferred from the history of geography that in medieval and early modern times geography was taught as part of mathematical courses in academies and universities in England, and on the European continent. Several mathematical

geographies appeared in Europe that were intended for general information of the geographer and mathematician. How widely they were used as a textbook for a course by that name is not known.

In America, perhaps the best known and most widely used book on mathematical geography was published by Willis E. Johnson, in 1907. It was written because the author believed that the mathematical portion of geography was the most difficult, the most poorly taught, and the least understood of all the subject matter of geography. At that time the mathematics needed was scattered through various courses of mathematics, astronomy, and to some extent, in physical geography. Since 1907 even less space and time has been given to the treatment of mathematical geography, instructors of both geography and mathematics no doubt believing that the other was teaching what was needed, with the result that very little needed knowledge was gained in this respect by the geography student.

The addition of service courses by the various departments for instruction of material derived from other subjects has, as a rule, not been successful. A better plan would be for the instructors in their own fields to point out the various uses to be made in other fields of the material that they were studying. This would not only make their work more valuable, but also more interesting.

In the case of geography and mathematics a survey of geography textbooks commonly used in the grade schools indicate that there seems to be quite a difference of opinion by textbook writers on the amount of mathematics needed by the geography student. Some, written strictly from the social point of view, contain very little reference to mathematical problems, while others recognize the need and frequently refer to mathematics for a better understanding of the subject; however, taking for granted that the student had learned this needed knowledge from his study of arithmetic. This list included the metric system; statute and nautical miles; practical uses of weights and measures of various kinds; short and long tons; cords of wood, cords per acre; gallons; bushels; barrels of various materials; bales by volume and bales by weight; horsepower; map scales; proportion; percentage; fractions; diameters; circumference, angles and degrees when dealing with the globe; tides; problems in latitude and longitude, and longitude and time; interpretation of time belts, and time at various parts of the earth; meridians and parallels; centigrade and Fahrenheit temperatures;

isotherms and isobars; acres of various countries; population per square mile when area and population is given; also various uses of graphical representation, such as vertical and horizontal bar graphs, line graphs, dot graphs, circle percentage graphs; and, in some publications, a various number of pictographs of doubtful mathematical accuracy.

Although the above are mentioned in grade school geography textbooks, a thorough mathematical understanding of many of the problems is usually not expected until the student studies geography in the third or fourth year of high school, or in junior college. Texts commonly used at this level not only include all of the above, but include a more thorough description of the movements of the earth, moon, and planets in space, and various changes occurring because of the angle of inclination of the earth's axis; and, duration of daylight, an understanding of which should include a workable knowledge of algebra and plane geometry. At this time the student is also expected to be able to handle minutes and seconds in dealing with latitude and longitude and with longitude and time. Complex fractions are also used more. A thorough mastery of the metric system would be a great advantage. A study of weather and climate includes changing of Fahrenheit to centigrade, and vice-versa; isobars; isotherms; isobars; relation of pressure in inches to pressure in millibars; relation of wind velocity to pressure gradient; relative humidity expressed in the form of a ratio, fraction, or percentage; weight and pressure; calibration of thermometers, barometers, and altimeters; distribution of gases at different altitudes; temperature inversions and lapse rates; and, mathematical representation of climatic data. At this level a study of trigonometry would be helpful. Economic geography at the college level includes not only an understanding of graphical representation, but also practice in figuring production of various articles and products, and construction of accurate graphs to show what has been found or produced.

For a good understanding of advanced meteorology and advanced cartography a knowledge of algebra, geometry, trigonometry, and spherical geometry would be necessary, with advanced mathematics very helpful. The construction and interpretation of various map projections still confuses the geography student, while the preparation of a correct flat map of the earth is still a perplexing problem to both the geographer and the mathematician.

HYDROGEN BALLOONS, WINDS, AND WEATHER

SARAH BENT RANSOM

State Teachers' College, Montclair, New Jersey

TEACHER'S STORY

The seventh grade general science class at College High School, Montclair, New Jersey performed an experiment with a hydrogen balloon which proved to be rather interesting. This experiment was done as part of their work in the study of weather and weather forecasting. A committee of students from the class performed the experiment to study balloons in free flight. Two groups of four balloons each were tied together with cards attached so that they might be returned when found.



FIG. 1. Possible Route of Balloons.

Various degrees of inflation were used so as to allow for expansion in the high altitudes of the atmosphere. One group of balloons was returned from Higganum, Connecticut which meant that it could have travelled from 150 to 200 air miles from Montclair. The other group has not been heard from.

The committee of students wrote up an account of the experi-

ment and it appeared in the school paper. The story as they wrote it follows.

CLASS STORY

The first step of our experiment was to make the hydrogen. To obtain this gas it was necessary to gather the needed apparatus. Eight generators were prepared, each with a florence flask, rubber stopper, cork, string, delivery tube, and a rubber balloon. The chemicals needed were zinc and hydrochloric acid.

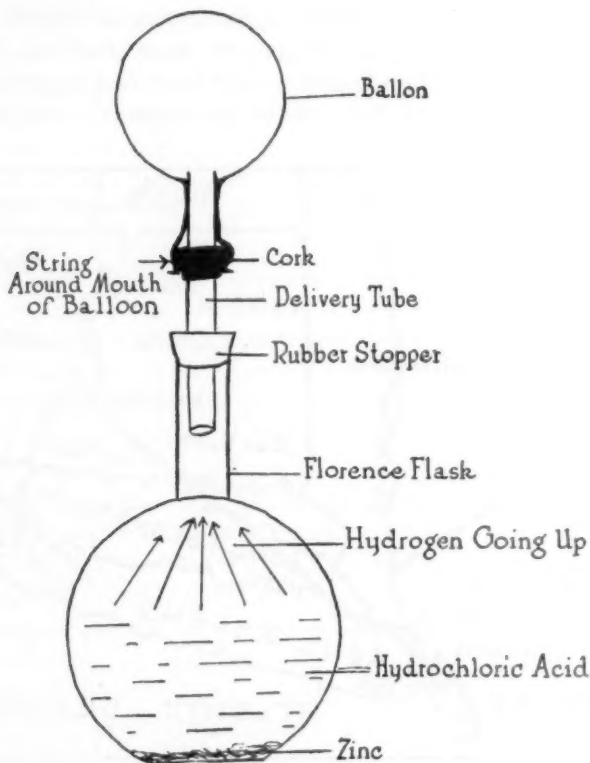


FIG. 2. Hydrogen Generator.

The zinc was placed in the flask and dilute hydrochloric acid was poured over it. The delivery tube was pushed through the stopper which was then placed on the flask. On the end of the delivery tube was a cork stopper which fitted the end of the balloon. After the balloon had been safely tied on to the stopper with string, it expanded quickly.

An important part of the experiment was the card. This was a penny post card with a one cent stamp printed on it. It was self addressed. The back of the card read as follows:

TO WHOM IT MAY CONCERN:

It would be greatly appreciated if you would send us this balloon and card to complete an experiment.

Please fill out;

Where found_____

Finder's name_____

When found_____

Finder's address_____

This, of course, was written in india ink so it would not run if it were caught in bad weather. After the balloons had been blown up and the card attached, we took them out to the back of the school. With a last farewell we sent them up. This was about 10:30 on March 31st. The wind was evidently Northwest, as the balloons travelled Southeast. They changed their course to a Northeast direction as they got higher up. They rose very quickly and were soon out of sight.

After sending up the balloons, and by April 20th, having received no news about them, most of us were pretty well discouraged and thought that we would never see them again. Imagine our surprise when the news spread through our class that they had been found near Higganum, Connecticut! The following letter was read in our next science class.

"To whom it may concern:

I am sending the balloons with the card attached, that I found while trout fishing Saturday, April 15, 1944. I found them high in the bushes and the place is near the cemetery in Little City, Ponsett, Conn. near Higganum.

My name is Joseph Scarb.

My address is Higganum, Conn."

We were so pleased with the results of our experiment that we decided it would be very interesting to study the probable course of our balloons, and also to learn something about weather balloons.

Taking up this subject of weather balloons proved to be very interesting. We had several movies about weather balloons on which we wrote summaries. They told how pilots and airmen used important weather instruments such as the barometer, thermometer, hygrometer, anemometer, pilot balloons, and sounding balloons. We learned that a parachute carries the instruments safely to the ground after the balloons burst.

There were two letters written by pupils of our class concern-

ing the balloons. They were to the Weather Bureaus at Washington, D. C. and New York City, N. Y. The letter was:

"Gentlemen:

We the members of the seventh grade of College High School, Montclair New Jersey would greatly appreciate it if you would kindly answer two questions. We sent up two hydrogen balloons on March 31, 1944 at 10:30 A.M. and received a reply on April 20th that they were found near Higganum, Connecticut. We tried to trace the air route of the balloons and found three possible routes they might have taken. Could you possibly tell us the wind velocity and the direction of the wind at that date?

Thank you for your time and trouble.

Very truly yours,
The Seventh Grade"

We received an answer on April 29th.

"Dear Students:

Reference is made to your letter of April 24, 1944, requesting information regarding winds on March 31 between Montclair, New Jersey and Higganum, Connecticut.

Since we do not know the size, free lift, or the ascensional rate of the balloons released by you, we cannot determine the exact conditions it encountered. A study of the prevailing winds show the following general situation at both New York and Hartford:

West to WNW winds between 13 and 38 miles per hour existed between the surface and 8,000 ft. Mostly SW and force increasing at 10,000 ft. Southerly winds of approximately 80 miles per hour at 20,000 ft.

Very truly yours,
J. B. Kincer
Chief, Climate & Crop Weather Division"

Our entire class has agreed that this has been a very interesting and successful experiment. This study will help us in our future life, since after the war is over the world will be greatly developed in aviation.

COMMITTEE WHICH PERFORMED THE EXPERIMENT FOR THE CLASS

Henry Allen, David Berry, Mary Clay, Sheila deVries, Bettejane Hendershot, Jean Koons, Suzanne Lewis, Arthur Lobsenz, Peter Stein, David Repass, Paul Wert, Betty Willette, and Janet Woodall.

SOUND RECORDINGS

Sound recordings on film are made without processing and may be reproduced instantaneously by a new instrument that consists of an electromagnetic dual-purpose head, for recording and playback, a sapphire stylus, motor and controls. The sound track is cut as in the ordinary wax record.

WHAT ARE PATENTS?

WILLIAM S. HILL

*Member, Examining Corps, United States Patent Office,
Richmond, Va.*

It is not exactly a compliment to American educators that most students are never introduced to their country's patent system. If any secondary school course of study includes provision for instruction about patents, the writer has never seen it or talked with anybody who has. But, what is far more serious, most colleges totally neglect this field, too.

Teachers cannot instruct others on subjects about which they, themselves, know nothing. Any teacher knows that he is often expected to try, however. There have been at least two reasons why science teachers have not instructed their students about patents. First, they have had no factual data on the subject readily available. Second, they did not think it important.

PATENTS DEFINED

Just what are patents and what are they not? A patent is a right conferred by the Government for a period of seventeen years on an individual or partnership who has purportedly invented or discovered some novel art, process, machine, or composition of matter. Patents are not granted for the discovery of hitherto unknown natural phenomena. Neither are they granted for mere suggestions or ideas which have not been reduced to practical form. A patent could not be granted, for example, on the idea of running a motor using the energy of cosmic rays. But a patent could be obtained on the machine, itself, if it were new.

The subject of a patent must be *novel*. That is, it must not have been shown or described in any printed publication, or known or used either at any time before the present invention was *completed*, or more than one year prior to the date the patent was *applied for*. It must also not have been on sale or in public use or had application for a patent filed in any foreign country by the present inventor or anyone legally connected with him, more than one year before the present filing date. The specifications of earlier issued patents are considered just as any other publication. Also, the antiquity of the publication has no bearing on its use as a reference. A clay tablet from ancient Egypt might possibly be just as effective a bar to a man seeking a patent as an article in some back number of this journal.

What kind of right does the grant of the patent confer? It merely gives the inventor the right to prevent others from making or using his invention without his consent. It does *not* necessarily give him the right to exclusive use or the right to exploit his invention in any manner he sees fit. There are anti-trust laws and fair trade laws which protect the public in this respect. Lack of knowledge as to how these protective statutes operate, leads many to regard a patent as an absolute monopoly. This is an entirely erroneous idea. The courts have handed down many decisions in recent years heavily penalizing attempts to fix prices illegally or unfairly on patented products.

IMPORTANCE OF PATENTS TO AMERICAN INDUSTRY

The engineer, in attempting to utilize a certain known process in working out a successful manufacturing process for his employer, often finds that the process has been patented. This may lead him to theorize that patents are not of benefit to the general public because they hinder advance in the art. Clearer insight shows that this is the exact opposite of the truth. This country's industrial achievements have been built on patents and reached no degree of importance until we had a good patent system. The inventor is not a man who greedily grabs something out of the public domain for himself and exacts tribute from everyone who wants to cross his little section. The inventor is a public benefactor who is giving the public something it did not possess before. He may have spent many months or years of toil in perfecting his invention. He may, like Charles Goodyear, have spent all his own money plus all he could borrow from his friends. He did it, secure in the belief that he could obtain a patent and prevent others from stealing his new product or process as soon as it appeared on the market. In return for his patent protection he must disclose to the public fully, all the secrets he has worked so hard to develop. The public, with this as a foundation, is then able to begin improving on the original process and industry is able to advance more rapidly. How much would Charles Goodyear or his backers, or Edison, or Bell have been encouraged to invent without a patent system? Look back to the time when there was no such system if you want the answer.

HOW PATENTS ARE DRAWN UP

In order to better understand how patents are drawn up, we

must define what is meant by "specification" and "claims." The specification is a complete description of the invention. It usually includes a preliminary statement as to what the supposed improvement relates and goes on to state the objects of the invention, how the machine operates, the process is carried out, or the article is made. It must also point out in what way the present invention is an improvement over existing devices, processes, or compositions of matter. If a drawing is needed to make a process clear, it must be included. If an apparatus is being claimed a drawing must *always* be included. The drawing must not be just a blueprint of the machine. It need not be drawn to exact scale but must be presented in such a way as to bring out the novelty. The Patent Office maintains a staff of draftsmen who will furnish drawings at nominal cost if desired.

Do not send models unless requested to do so. That practice was discontinued many years ago.

The Patent Office always checks the specification for errors and ambiguities but it is the claims which are examined for invention. Each claim must be a carefully worded statement of some part of the supposed novelty. If the invention is a composition of matter, each claim would be drawn somewhat like a statement of the ingredients of a recipe. However, it may not be as definite or unequivocal. For example, instead of referring specifically to a resin as polyvinyl acetate having a certain molecular weight and viscosity, the claim may be drawn to the use of a polyvinyl resin, or a polymerized vinyl ester resin. It all depends on what the specification has disclosed. If many examples are given they may be made the basis of broad claims. The general rule is that a man must have disclosed several chemical equivalents if he wants to claim use of the entire series to which those disclosed equivalents belong. Usually the inventor tries to have the Patent Office accept the broadest claims to which he is entitled. But they must be worded so as to distinguish from all prior published matter—which is a big order.

SPECIAL FEATURES OF THE U. S. PATENT SYSTEM

Although many other countries have patent systems ours is generally regarded as being the best and at the same time the one after which many others have been modeled. Some of its distinguishing features are:

1. Systematic examination system to determine whether a patent should be granted.

2. The first to complete the invention, and not the first to file application for patent, is regarded as the legal inventor.

3. Moderate cost in government fees compared to services rendered.

4. Absence of many licensing restrictions and controls which discourage inventors of other countries.

The systematic examination system was established in 1836 although our national patent system, itself, dates back to the Constitution and the first Continental Congress. The use of a systematic examination simply means that every application for a patent is assigned to an examiner who makes a search through existing publications of all kinds to pass on the supposed novelty. In practice, this means a search mostly through the specifications of prior issued patents, both domestic and foreign (when available). Domestic patents are classified in more than three hundred classes. Each class is further subdivided into subclasses which may also run into the hundreds. A staff of classification examiners spends part of its time working constantly to keep the system up-to-date. This is no small job in certain electrical and chemical arts which are developing rapidly.

Of course, a complete search also includes the use of treatises, abstracts, textbooks, trade journals, and every other kind of publication under the sun. Reliance is placed mostly on patents because they are more readily available in organized form. Failure to find anticipating patents usually sends the examiner into the wider field of search.

WHEN TWO OR MORE INVENTORS CLAIM THE SAME THING

To the dismay of the inventor of limited capital, it happens only too often, that he is informed that someone else has an application for a patent in the Patent Office with claims just like some or all of his own. Then an "interference" is declared and this initiates expensive proceedings to determine who was the first inventor. A special interference examiner listens to the testimony introduced by each competitor and, after allowing each to present his case fully, makes an award of priority. It isn't quite as simple as this statement sounds. There is usually a great deal of maneuvering by both parties before it is finally settled. Then the decision may be appealed to certain courts in the District of Columbia.

This is an expensive proceeding but is really much better in the long run than awarding priority to the first to file in the

Patent Office. This latter practice, adhered to in many foreign countries, results in many applications being hastily filed just to beat the other fellow to the line.

COST OF A PATENT

The filing fee for an application containing twenty claims or less is now thirty dollars. There is also a final fee of thirty dollars which must be paid before the patent issues. If none of the claims is allowed by the examiner, of course no patent can issue, and the final thirty dollars remains unpaid. The patent application then becomes abandoned and the office copy is placed in the "abandoned files" in the Commerce Building, Washington, to gather dust. Abandoned files are not open to the public. Only the Patent Office, certain other government departments by special order, the applicant, or his legal representative may have access to abandoned applications or any other application which has not yet issued as a patent. As a rule, about 30 or 40 percent of all patent applications become abandoned for one reason or another, the most important of which is lack of invention.

Sixty dollars may seem like no small cost in government fees just to obtain a patent paper whose only adornment is an impressive looking seal and a strip of blue ribbon. But in most foreign countries the fees run up to many times this amount. The fees paid to the Patent Office in normal times just about balance the cost of running the office. Prior to the present war the office generally returned a small profit to the treasury. Now it is forced to run at a deficit made up out of public funds.

Then why the greater cost in other countries having less costly organizations than our own? Most of them have a system of patent taxes and license fees which depend on the number of years the patent runs. In Germany a seventeen year patent could cost many hundreds of dollars—at least, before the present war.

The real cost of a patent is not the fee paid to Uncle Sam. In order to obtain a patent with skilfully drawn claims and specification it is almost a matter of necessity for the inexperienced (and even the experienced) inventor to hire a patent attorney to prosecute his application. This usually costs upward of two hundred fifty dollars. It is hard for the ordinary citizen to understand why his government, to whom he is willing to pay his sixty dollars in fees, should treat him like this. Why should getting a patent be so complicated that he has to hire an attorney?

The answer is, of course, that he doesn't have to hire an attorney if he does not want to. But, for the same reason that almost no man in his right mind ever goes into court on an important case without an attorney to protect his rights, he should also not attempt to prosecute his patent application without experienced legal aid if he has something he considers really important. It may mean the difference between royalties of millions of dollars and having a worthless scrap of paper.

The patent office employee is always asked why the examiner cannot see that justice is done to the applicant. Why cannot men be assigned to help him draw up his specification and get his claims in shape? To answer that, just ask yourself this one question. If you were an examiner would you want to be responsible for telling a man exactly how to draw up patent claims and then have him hold you at fault if the courts later declared the claims invalid?

At one time the Patent Office did take more pains to help individual inventors. This practice was modified when found to be impracticable. Examiners still do all they can, in the short time allotted each application, to help an applicant correct his specification and write valid claims.

It is impossible to go into a thorough discussion of patents in a few words no matter how well chosen. The writer recommends that the teacher or pupil order copies of the patents, digests of which appear in other journals regularly for a period. Address the U. S. Patent Office, Washington, D. C. and enclose ten cents (not stamps) for each copy desired. Only limited numbers of each patent are available. The patents, themselves, will often turn out to be excellent reference material for the science teacher.

Before the teacher or student starts ordering patents he should understand that each patent does not usually represent some great and radical advance in the art. Most of them are drawn to small but significant improvements. Often the validity of a claim will turn on a single word.

It is generally accepted now that patents cannot be granted for merely obvious changes in an existing process or machine, which any mechanic would try if the problem were proposed to him. There must be some unexpected result obtained or the improvement must have required some research or, at least, mental gymnastics. The Supreme Court¹ recently went so far as to say that an invention must exhibit the "flash of creative

¹ *Cuno Engineering Corporation v. Automatic Devices Corporation*, 62 S.Ct. 37; 51 U.S.P.Q. 272.

genius." But since nobody knows just what that is, the patent profession has not been much enlightened.

America, as this is written, is still the Land of Golden Opportunity for the individual. Countries like Russia have patent offices—yes, but the inventor gets a certificate of merit, and some reward determined by his government, usually not comparable with what he could win for himself under our system. The new frontiers in this country are now mainly the frontiers of science. The patent system plays its part in encouraging Americans to advance the part of the frontier which borders the land of "Practical Arts."

SCHOOLS RACE PAST \$500 MILLION GOAL FOR OVER \$600 MILLION IN 1943-44 WAR SAVINGS

This is better than 20% above the goal of \$500,000,000 and early year-end estimates of \$510,000,000.

"A half billion dollars and more is a lot of money for the school children to have saved for Stamps and Bonds," was the comment of President Roosevelt when he received the official 1943-44 Schools-at-War report inscribed on a Jap propeller tip shot down in the Pacific. The presentation was made in the White House library by a 13-year-old Virginia school boy who had helped to organize his school's monthly War Bond rallies, had raised the Schools-at-War flag each morning, and had himself earned enough money for three War Bonds since Christmas.

Previously, elaborate ceremonies had been held at Stout Field, Indianapolis, when the school-financed war equipment was accepted for the armed services. In a literal sense the Stout Field presentation became a Report to the Nation, for it was featured in a Newsreel released in every theater during the last two weeks of the Fifth War Loan. The movie also included several shots made in the Indianapolis schools where students were shown buying and selling War Stamps in the classroom, pasting up their Stamp albums and working to earn money for more War Bonds.

The saving of American school children added up to more than \$600,000,000 worth of trouble for the Axis—this school year.

At first the youngsters concentrated on jeeps and paid for 33,100 jumping jeeps at \$1,165,11,600 amphibious jeeps at \$2,090, and 11,400 flying jeeps at \$3,000. For good measure they threw in 7,690 parachutes, 6,170 life floats, and 5,190 motor scooters.

At the same time they ran campaigns by the thousands for field ambulances, sets of clothing and equipment, diving outfits, motorcycles, potato peeling machines, army mules, tanks, and walkie-talkies.

Not content with their own savings and the campaigns within their schools, the youngsters in the past year have made a concerted effort to take War Savings to the community. They have become educators for personal savings and frequently have taken over as efficient salesmen to follow up their lessons with practical applications.

During the Fourth War Loan, it is estimated that over \$229,000,000 in War Bonds were sold through the schools. In many communities the boys and girls took entire charge of the Fourth and Fifth War Loan Drives.

As the school War Savings program enters its third year, the entire nation is looking to the schools for enthusiastic leadership.

PHOTOGRAPHY IN THE ELEMENTARY SCHOOL

LELA VAN ENGEN

University of Wyoming, Laramie, Wyoming

Is photography too advanced for the elementary school? Many children have miniature chemistry sets at home. Others have small sets which they use for developing and printing pictures. They are fascinated by the magical changes that certain chemicals make on different things. If some father is kind enough to demonstrate the different phases of photography in his own dark room or better yet, if the school system has a dark room with the proper equipment, the children will have a fine experience of seeing the changes that take place in developing and printing a film.

Children should learn how the film is put into the camera. It is better to use an inexpensive camera. How many times haven't we heard an adult say, "Oh, I never could put a film in a camera, will you do it for me?" When it is explained to children that it is just a matter of wrapping the protective paper around a spool which is placed in the camera, it seems relatively simple. There is little chance of ruining the film unless the child allows the whole roll to become very loose allowing light to reach the film. Usually there is sufficient protective covering around the outside so that much of it can be unrolled before damaging the film.

In studying the camera children should know the different parts and what they do in taking the picture. An understanding of the sight, shutter, box, diaphragm, distance scale, time or instantaneous regulator and lens will aid the child in taking pictures.

They often do not understand the idea of "focusing." A good example is to have them look at the windowpane and when their eyes are focusing on the window the trees in the street are not clear. When they focus on the trees, they no longer see the windowpane. As our eyes focus on different things so does the camera if we remember to set the distance scale. Improper focusing or moving of the camera will make a picture fuzzy or blurred.

The object of interest should not be directly in the middle of the picture but slightly to the left or right of the center. A good rule for landscapes is to have some object in the foreground to give a third dimension or a feeling of depth. People are more interesting if they are doing something rather than just posing

for a picture. A picture shouldn't be filled with a lot of different things. Take a picture of one thing at a time.

Some people think that the time to take a picture is after ten in the morning and before three in the afternoon. This is not correct. You can usually get better results by doing just the opposite. The more at an angle the sun strikes the earth and the longer the shadows the better the picture will be.

There are three common kinds of films. The first, the color-blind film or "N.C." film is the one that we used before the orthochromatic films became so popular. Second, the orthochromatic film. If the trade name has "chrome" in it, it is this type. And the third type is the panchromatic which is a very fast film. The first two films can be developed in the dark room using a red safelight but the panchromatic has to be developed in complete darkness.

After the picture is taken, there are two other things that must be done before it is finished. The first of these is developing

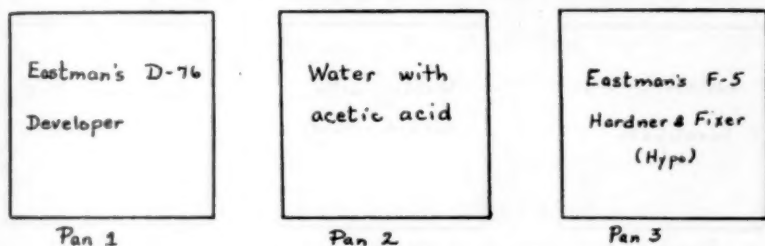


FIG. 1. Developing films.

and the second is printing. Each film has a protective coating of paper because the film is sensitive to light. The dull side of the film is next to the paper and is called the emulsion side. The other side is shiny. The film is unrolled in the darkroom with only a red light (no light if it is a panchromatic film) and protective paper removed. Care should be taken not to get finger marks on the film. By holding the film with both hands it can be see-sawed back and forth through a pan of developer. Eastman's D-76 is a good developer to use. The directions for mixing it are given on the container. Two portions of developer and one of water are mixed for the first pan. If the film curls too much, it can be moistened in water before it is put in the developer.

The film should be kept in motion for about fifteen minutes and then washed in a pan of water with acetic acid or vinegar. A few drops of acetic acid in a quart of water are sufficient. From

there it goes to a pan of hypo (Eastman's F-5 Fixer and Hardner) where it is left until the yellow backing has disappeared from the film. It should be left in the hypo twice as long as it takes it to clear in the developer. The film is then put in a tank of running water and washed thoroughly.

When the film is ready to dry, put a safety pin through one corner or use film clips to fasten it to a line. One of the clips can also be used at the bottom of the film as a weight. Wipe the dust particles and water drops off the film with a clean wet sponge. It is wise to let the film dry for several hours before printing.

For printing a printer and three pans which contain developer, water with acetic acid, and hypo are used. The negatives are cut apart and are put into the printer one at a time. Photographic paper Velox F-3 can be used for the beginning contact printing. F-1, F-2, and F-4 paper can also be used according to the type of negative. The sensitive paper is exposed by placing the emulsion side of the paper against the emulsion

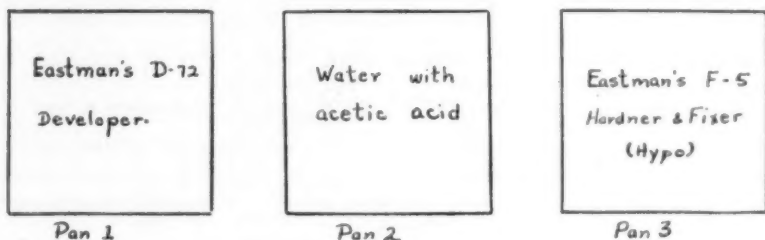


FIG. 2. Printing negatives.

side of the film and then shining a light through it while counting "one hundred naught, one hundred-one, one hundred-two, and one hundred-three" slowly.

A dull yellow safelight can be used in the darkroom during the printing. From the printer the negative is put in the developer (a mixture of two portions of Eastman's D-72 and one portion of water) for about thirty seconds. If the print is too dark, it was exposed too long in the printer. If it is too light, it wasn't exposed long enough. It is rinsed in the water with acetic acid and then left in the hypo for at least fifteen minutes. From the hypo the prints go to the water tank where they are washed.

The prints may be dried on ferrotype plates or on a clean white cloth. A ferrotype polish (composed of ten grains of paraffin to an ounce of benzene or clean gasoline) is used on the ferrotype

plates so the prints will not stick. Place the prints face down on the plate and roll them with a rubber roller to squeeze out any excess water. When the prints are dry, they will peel off the plate.

The fourth grade of the University Elementary School found this to be a very interesting unit. There is a great amount of satisfaction derived from a constructive activity of this type. It not only is educational but may develop a hobby which can be interesting throughout life.

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3. Collins, Frederick, *Photography For Fun and Money*, D. Appleton-Century Co. New York. 1939.
4. Doubleday, Russell. *Photography Is Fun*. Doubleday, Doran and Company, New York. 1938.
5. *How to Make Good Pictures*. Eastman Kodak Company. Rochester, N. Y. 1943.
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THE CHEMICAL SHOW AT CHICAGO

How the chemical industry has contributed to the war effort and its effect on the immediate post war period will be emphasized at the third National Chemical Exposition and National Industrial Chemical Conference to be held Nov. 15 to 19 at the Coliseum in Chicago under the sponsorship of the Chicago Section of the American Chemical Society.

"Every telling blow rendered by our armed forces against the enemy brings us nearer the peace," said M. H. Arveson, chairman of the exposition committee. "It is a widely known and accepted fact that the chemical industry is taking a major part in the war effort. It reaches into virtually every industry and every product and is credited with scientific advancements that have contributed to the assured victory of the Allies.

"The show and conference will have a new significance, therefore, this year. It will depict the science of chemistry in many of its phases and its application to industry and the needs of mankind in peace as well as war-time."

Mr. Arveson said that new discoveries and products which have been developed during the war by the chemical industry will soon play an important part in providing luxuries as well as the necessities of life for civilian use.

"Just at present we are facing the problem of providing additional space to accommodate an almost overwhelming demand," said Mr. Arveson. "We are negotiating for the North Hall of the Coliseum which will yield 71 additional spaces if we can complete the deal."

WE CALL IT SNW

G. W. MOUSER AND MARGARETEVA R. SIMMONS
Greenville High School, Greenville, Illinois

IT STARTED LIKE THIS

As a boy of high school age, I worked in a grocery store. Ebe, the manager, was always a few steps ahead of the game in matters of merchandising. Well do I remember one of his plans in introducing new merchandise. He would say, "Boys, I want a big display right in front of the door so people will have to walk around it. Build it so they can pick up a can for themselves." But Ebe didn't stop here, for he knew people too well. He knew they wouldn't all take the time or the trouble to handle the item for themselves. Accordingly, he carried a sample with him whenever he went about his work, always one at his desk or with him to the phone. All day long the product was within reach so that he might literally lay it in the hands of that customer who lacked the initiative to reach out and pick up a can for himself. To be sure, he wanted them to read and hear about it all, but his final point of strategy was to see that they actually tasted, and so with paper cups and wooden spoons the sale was completed. Did it work? Our bunch would say, "Are you kiddin'?"

Are we barking up the wrong tree to draw a parallel to these methods for selling our nature study program? At any rate we are out to sell with the same determination. Key teaching aims do parallel merchandising at its best.

Accordingly, in as subtle a way as possible, we have set out (1) to sell our group on the need of nature knowledge. (Possibly the biggest need seen at first is a sufficient knowledge to be able to get some of the club awards, special prizes, or special club trips.) (2) To hold this interest after we have it. (3) To establish and constantly improve a program of activity which will lead one on until it has him doing things on his own. I feel we are having a degree of success in carrying out our club work, and with student help we tell a few of our experiences.

Before taking up various aspects of our club work, may I point out our triple conservation program? (1) To the extent that our plan works, we claim credit for conserving our youth. (2) Through them we teach and conserve American ideals. (3) Through our "Know Your Nature" program (education and appreciation) there is bound to arise a love for nature and sub-

sequent concern which manifests itself in an active interest toward conserving these natural resources. Are these worth while?

Club features which immediately follow are presented by student club members. The teacher evaluation at the close is written by Miss Margareteva Simmons who is co-counselor and instructor in general science; also one by Mrs. Martha J. Pulis of the English department who is our school librarian. Both of these instructors have joined us after our club was started. Their specialized contributions to the club through the services they render as counselor and club librarian are invaluable, and if it can be said that we are meeting with any degree of success, this splendid phase of the set-up, namely, inter-departmental co-operation must not be overlooked.

—G. W. MOUSER

AIMS OF OUR CLUB

There are, according to my opinion, at least five groupings of the aims of our Nature Club.

1. Probably the first and most outstanding of our aims is to be able to call our nature friends by name when we see them, and also know a little more about them, their habits, and ways.

2. Definite attention is given toward developing attractive character with well-balanced interests, and the will to work and attain definite goals.

3. We are building clear cut plans for future use of leisure time. In our club we find clean recreation, and invaluable experience in learning how to plan for such recreation.

4. If we are to succeed in our nature work, we must become accurate observers and recorders. We must be able to remember what we see, and special training is offered toward this phase.

5. If we are to tell others effectively, we must all be good leaders, and to be good leaders we must be accurate describers and good listeners. All of these have received definite stress in our club.

If we have a goal other than those above stated, it is that we covet the respect and admiration of our own high school, the interest of our entire city, and a hope that our efforts may even be felt in some little way as a starter toward a nationwide campaign for the conservation of nature's resources.

There is no stopping place in our program; it can engage us to our last days.

—ALICE KOONCE

CLUB PROGRAM

"Would you like to be able to greet Mother Nature's children by name when and where you meet them?" This challenge, presented by our counselor, Mr. Mouser, was accepted by a dozen students and was the beginning of our SNW Club. As a charter member, I have seen this club grow. In all its growth our efforts were then and are now centered on knowing nature.

It falls my lot to outline the program around which all our activity is built. Briefly, our learning is based on unit achievements, 35 in all. To earn the much coveted SNW Naturalist title and the sterling silver key we must have satisfactorily completed 25 specified units. Other awards are explained elsewhere.

The units might be grouped under several titles or objectives as follows:

1. Character and personality are developed.

Through these units we develop character by proper respect to superiors, God, parents, teachers, elders, and develop personality by learning to work and live with others.

2. Scientific attitude, reading, observing, and recording are developed. Units which cover these points help us to evaluate and draw our own conclusions, to think and to improve our minds.

3. The ability to identify and classify the more common members of the plant and animal phyla—to have a good working knowledge of the things we touch, see, and hear daily is developed. Among these are fish, flowers, frogs, weeds, cows, horses, dogs, cereals, insects, reptiles, trees, birds, rocks, minerals, fossils, soils, stars, visible planets, thallus plants, and others too numerous to mention.

4. To learn by doing. We work and watch:

- A. All Night Vigils

- B. All Day Hikes

We apply our knowledge:

- A. Building

1. bird houses

2. feeders

3. shelters

- B. Investigation

1. dissecting

2. mounting

3. combing ponds and fields
5. To encourage conservation.

In these units we make nature and conservation exhibits, interest other people in conservation and nature, procure funds for other conservation organizations. There is a unit in which members sign a pledge that they will not kill certain kinds of game for a period of four years, in order to stimulate an interest in the conservation of game which is decreasing.

—WM. LEHN

CLUB ORGANIZATION AND FUNCTION

Our club organization is essentially simple. Of course, it is not our purpose to create a perfectly functioning parliamentary body, though all meetings are strictly student conducted according to parliamentary rules of order. We do aim to have sufficient organization to keep things running smoothly and efficiently and to encourage student participation and expression.

Our student officers are president, vice-president, and secretary-treasurer. Faculty members who work with us are two counselors and a librarian.

Club programs, public programs, and various club policies are guided by our so-called executive committee, composed of all the student officers, two club members chosen at large, and the two counselors.

Regular instructional meetings are held once a week on Wednesday night from 7:30 to 9:00, and at this meeting, special topics are considered in one of the following ways: counselor talks, movies, opaque projection, slides, etc. All work, of course, centers around our Unit Study Plan. Special project nights, bird feeders, plaster track making and the like are worked in also.

Business is conducted during our school activity period. The first and third Mondays of the month are used for committee meetings, and the second and fourth for the business meetings of the club.

In addition to our regular club meetings we present a varied number of public programs during the year. For at least one meeting a year we attempt to present some guest scientist of note. Proceeds from these programs are used to further club activity.

Local activity is supplemented with trips to zoos, field museums, botanical gardens, and other such places. All of us look

forward to the spring and fall trip to Pere Marquette State Park. The car seats are filled first with the more faithful and so on down.

Finally, I should not fail to mention our contest and contest awards. Our counselors are diligent in keeping some sort of contest before us. As for the awards, they speak for themselves: field guides such as Peterson's Bird Guide, Lutz' Insect Guide, Matthews' Trees and Shrubs, or supplies for our club work, pencils, pens, looseleaf binders, etc.

—MARY LAMSON

SNW DEGREE AWARDS

SNW awards are given for two primary reasons. One, to stimulate interest in the activities and programs of the club; the second, to offer public recognition for the various achievements both at the time of the presentation of the award and in the wearing of it afterwards.

Our first award is the membership certificate. This is an award and must be earned. One complete semester of honest work and steady attendance in the SNW earns one the right to apply for a certificate and subsequent membership, which requires a two-thirds vote of acceptance by the members.

After completing one year of satisfactory club participation, one receives a leather SNW emblem.

All other awards except club contest awards are based on unit achievements. They are listed.

1. The degree of *Cub Naturalist*, with an appropriate sleeve emblem, is awarded for the completion of the equivalent of one-fourth of each required unit and one year's membership.

2. The degree of *Pioneer Naturalist*, also with a sleeve emblem is given after the completion of one-half of each required unit and two years membership.

3. *Junior Naturalist* is the third degree. It is given for three-fourths of each of the required units and three years membership.

The degree of SNW Naturalist and the SNW key is awarded upon the completion of all the required units.

—GLORIA ELAM

CLUB MEMBERS SPEAK

In answer to a recent contest topic, "Why I Like SNW" students have the following to say:

We have fun and do our best to help our community. We learn to admire Mother Nature.

—James Hannum

I like SNW because it stirs up something in you; makes you willing to get up early or stay up late to learn interesting things.

—Esther Herman

Our Counselors give us a chance to pick our own officers and run our own club. We are one happy family with no "know it alls" in our group.

—Charles Marshall

The fact that our nature knowledge does not all come from books makes it even more interesting.

—Zelda Hannum

SNW helps me realize what is going on about me in the beautiful out-of-doors.

—Violet Zimmerman

Any lines of previous scholastic reputation quickly disappear. Seemingly all have one and the same objective—through some means to add some new nature fact to our list daily. There are no social cliques.

—Doris Long

TEACHER EVALUATION

So Now—What?

My impressions are those of the new-comer since our club was in its second year when I started my work with the group. As I look back on these impressions, I find two which are outstanding.

First, I was much pleased with the scientific, businesslike attitude of these students in the field. Doubtless such an attitude explained a second, the unusual command of nature knowledge this group possesses, one, I dare say, somewhat above the average of high school youngsters.

With a fuller acquaintance of the club and all its activities other points stand out as an indication that our organization is meeting some of the needs of youth today.

Since the heart of the program is based on field recognition and subsequent understanding of various life forms, I will point out a few indications that these field experiences are doing something to us.

These bafflers that invariably confront the wide awake nature student are having a pleasing effect.

In the first place they are sending them back to the book shelves to books of reference, keys, and bulletins to a degree that we never have, and can scarcely hope to experience in our general run of biology classroom procedure. The fact should not be overlooked that 50 or more volumes of books and guides have been purchased through the department thus far this season by club members, and this has been entirely unsolicited by the counselors or librarian. Also many volumes from a variety of libraries have made their appearance at our desks through student investigation. Again, entirely student conceived and motivated, a group of 35 club members subscribed for a well-known general nature publication. Another indication of a broadened reading knowledge is displayed in an obvious consciousness of articles, pictures, etc. We are actually experiencing such sayings as "Did you see those cute pictures in this week's _____" or "Wasn't that story interesting about the little _____" or maybe "I found some more good reliable information about _____".

Secondly, SNW has vitalized our class room period. The SNW had a "star hike" a week ago, and saw the visible planets in the forenoon, through the telescope. During this hike, a student guide pointed out 20 constellations, their component star parts and magnitudes. Interest was high and this hike was discussed in classes the next day. Not long after that, one of the members, early one morning, reported to a counselor that he noticed on the way to school that morning that "Jupiter was 'actin funny'," and sure enough, evening papers carried the eclipse of Jupiter. Others of our members also observed these celestial happenings and reported them.

It has stimulated laboratory work to the extent that it has presented us with an acute problem: that of arranging a minimum amount of laboratory space and equipment for the best use of 85 biology students and 40 club members, few of which are duplicated, in the two groups, since many of our club members are former biology students. We are trying to correlate the SNW work with our respective class instruction. This, however, does not eliminate our own problem, because we are not set up to make an out-and-out switch to our club methods of teaching.

Listed below are a few other indications that the plan is working.

1. Consistent attendance.
2. Early morning hikes are supported very well.

3. An ever constant request for a hike into the fields, warm or cold—rain or snow.

4. Indications of an ever widening field of interest—I understand that the club was originally a bird club and some of the members were reluctant to go out and look for insects, stones, and stars at first, but this reluctance has disappeared. Now each tries to be the first to be able to identify a herd of cattle, a flock of chickens, a tree, a group of birds, a bird call, a rock, or a frisky dog that bounds out to greet them.

5. We have several students capable of acquiring and holding the interest of those of their own age on various types of hikes. We call this leadership.

6. Scarcely a bird hits the town in migratory flight before his presence is recorded in some SNW notebook.

7. Already our efforts are being rewarded. A concern for the future of these Natural Wonders has been manifested. This one we scarcely dared to hope, but we have it—student members are in the foreground to catch the vision. Our club title and scope of work shall be modified to include conservation and all the name implies. (Knowledge Precedes Appreciation)

8. Finally, short though our club existence has been, we are looking forward to awarding several SNW keys, our highest award this spring

MARGARETEVA R. SIMMONS

Sees Now—Why

"What are you doing here?" That question from my superintendent made me think. Why am I here at the SNW meetings? My first answer is curiosity. What does the SNW have that causes these youngsters to come up to the high school every Wednesday night at 7:30 and stay until they are practically chased out; what causes them to get up at all hours of the morning to go on hikes, whether it is to see stars, birds, tracks, or what not; what causes them to want to spend their extra time in the science room where the SNW meets; and what causes them to be ready to attend any emergency meeting which is called, to go anywhere, to do anything that is needed? What sort of organization can do that?

The members are a true cross-section of our school—all kinds—"A" students and flunkers, peppy popular students and shy, retiring ones, but in SNW they're all alike—vitaly interested in nature study.

There, I believe, I've found the answer—interest and desire to know the answers to their surroundings, whether it be on the ground, in the ground, or above the ground.

I came because of curiosity—stayed because I, too, became interested, and brought my daughters because I want them to have what SNW is giving to its members.

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THINK OF A NUMBER

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This fascinating game can be made the basis of a very effective introduction to beginning algebra.

For example, the teacher begins by asking each pupil to "think of a number," add 2, multiply by 3, and subtract 5. When the results of these computations are announced, pupils are invariably surprised and intrigued at the speed and ease with which the teacher "tosses back" the "number thought of."

With the pupils' interest aroused in this fashion, the teacher proceeds to reveal the secret of his method by placing on the board the following analysis;

x	number thought of,
$x+2$	add 2,
$3(x+2)$	multiply by 3 (indicated),
$3x+6$	multiply by 3 (effected).

Indicating the addition of 2 by $+2$ is familiar to the pupil from arithmetic. On the other hand multiplying by 3 to obtain $3x+6$ is a step well worth pausing over.

If the situation is put squarely before the pupils it will be found that they are quick to realize that 3 times $(x+2)$ means $3(x+2)$'s i.e.

$$\begin{array}{r} x+2, \\ x+2, \\ x+2, \\ \hline 3x+6. \end{array}$$

It is not difficult to get pupils to formulate the rule that to multiply the sum of two or more numbers one *must* multiply *each* number in the sum. When this principle has been made clear by a variety of examples there is no reason why the teacher should hesitate to refer to it as the *distributive* law.

If attention is called to the verb distribute and the noun distribution the meaning of the verbal adjective will be self-evident and serve to recall the principle. Thus we can say that the distributive law asserts that the multiplication of a sum is *distributed* (spread) over each of the items which make up the sum.¹

Coming back to our blackboard analysis, the next steps are,

$$3x+6-5 \quad \text{subtract 5,}$$

$$3x+1 \quad \text{simplifying.}$$

Pupils have no difficulty in understanding that if $3x$ is increased by 6 and diminished by 5 the net effect is to increase it by 1. Omitting reference to $3x$ we may say that increasing by $6(+6)$ and decreasing by $5(-5)$ is equivalent to increasing by $1(+1)$. In symbols,

$$+6-5 = +1.$$

In this way the pupil finds himself gravitating almost unconsciously into the vocabulary of signed numbers without any of the mysticism which usually accompanies their introduction.

Finally, the teacher shows that $3x+1$ can be equated in turn to each of the numerical results obtained by the individual pupils. Thus, if a pupil states that his result is 13, the teacher writes

$$3x+1 = 13.$$

It should be plain that if $3x$ increased by 1 is equal to 13, $3x$ must be 1 less than 13, i.e.

$$3x = 12,$$

¹ For a real mastery of the subject the verbal side of algebra is just as challenging and significant as the symbolic. The ability to express in words a relation such as

$$(a+b)^2 = a^2 + 2ab + b^2,$$

is a good test of the pupils' understanding and an effective aid in making the transition to such a problem as

$$(2a+3b)^2 = ?$$

Thus a teacher who found that some of his pupils could proceed from $(a+b)^2$ to $(x+y)^2$ but not to $(2a+3b)^2$ decided in desperation to state the rule as follows, any damn number plus any other damn number, squared, is equal to the square of the first damn number etc.

$$x = 4.^2$$

With games of this type the pupil can be introduced quickly and easily to selected algebraic situations which would otherwise be difficult to motivate.

Thus, resuming the game, the teacher may ask each pupil to subtract 2 from the "number thought of," multiply by 3, and subtract 5. After the pupils have announced their results and been intrigued by having the teacher respond with the "number thought of," the following analysis is placed on the board.

$$x, x-2, 3(x-2), 3x-6, 3x-11.$$

Here again the step which the teacher should "linger over" is the trebling of $x-2$ which, as might be expected, proves to be somewhat more difficult than the analogous $3(x+2)$. The procedure is the same, however. It should be clear that $3(x-2)$ means nothing more or less than $3(x-2)$'s, i.e.

$$\begin{array}{r} x-2, \\ x-2, \\ \underline{x-2,} \\ 3x-6. \end{array}$$

This result evidently conforms to the distributive law in that we have taken 3 times x i.e. $3x$ and 3 times -2 i.e. -6 .

$3x-11$ is then equated in turn to the results of the pupils' calculations. Thus if

$$3x-11=13,$$

x can be determined by "arguing" that if $3x$ diminished by 11 is equal to 13 then $3x$ must equal 24. Hence

$$\begin{array}{r} 3x=24, \\ x=8. \end{array}$$

As successive games are played, an increasing number of pupils develop sufficient self-confidence to emulate the teacher by performing the "master" computation in terms of x in preference to an individual arithmetic calculation. This spontaneous adoption of the "let x equal" principle, far from spoiling the game, actually represents a very desirable by-product.

² The tendency in textbooks is to omit this verbal analysis in favor of plunging precipitately into a mechanical "subtract 1 from each side" procedure.

An interesting *converse* aspect is illustrated by the following set of directions. "Think of a number," add 3, multiply by 2, subtract twice the "number thought of," etc. In symbols,

$$x, x+3, 2x+6, 6.$$

The teacher may elect to stop at this point and ask for results or he may suggest further operations which convert the 6 into any other desired number. Thus he may conclude with . . . , add 4, divide by 5, and subtract 2, in which event each pupil finds that he has *nothing* (zero) for his pains.

Pupils are quite surprised to find that in some mysterious way their computations have all led to the same result. This surprise is corroborated and explained by the fact that they are slow in seeing that the x which they had selected was eliminated in the fourth step.

The fact that the "think of a number" game can be made of any length and any degree of complexity makes it extremely flexible and available at every algebraic level for developing new and reviewing old principles. Thus an interesting turn can be given to a review of quadratics by such a game as the following—"think of a number," add 2, multiply by 2, subtract 3, add square of "number thought of," multiply by 4, extract square root.

The extension to 2 or more unknowns adds another dimension to "think of a number" as in the following game which is very effective in overcoming reticence (feminine or otherwise) in the disclosure of age. The persons participating are asked to take their age (x) double it, add 5, multiply by 50, add the (amount of) pocket money (y),³ and subtract 365.

The successive operations lead to $x, 2x, 2x+5, 100x+250, 100x+250+y, 100x+y-115$. If the result, for a given individual, is 2132, we have

$$100x+y-115=2132,$$

$$100x+y = 2247,$$

so that,

$$x=22, y=47,$$

which is promptly announced as—age 22, pocket money 47 cents. The participants in this mass "fortune telling" register the usual sharp surprise when confronted with the private information which they themselves have unwittingly furnished.

³ Since this is assumed to be less than a dollar and expressed in cents, y is less than 100.

With this additional evidence of range and flexibility it is clear that "think of a number" could serve as the sole source of application material except for the need of a still greater variety and the desirability of doing justice to such problems as distance, rate, and time, mixtures, etc.

We shall conclude with a number game which is very challenging and suitable for inclusion in a "think of a number" repertoire even though it does not require an x for explanation. "See-saw addition," as we shall call it, is limited to 2 persons but can be made interesting to a class by selecting (or electing) some pupil to serve as a "foil" for the teacher.

The pupil usually elects to begin, which he does, by naming a number between 1 and 5. The teacher in turn selects a number in the same range and adds it to the one chosen by the pupil. This back and forth addition procedure is continued until the game is won by the player who is first to succeed in bringing the sum to a preassigned value, say 52.

Like the Bergen-McCarthy recipe for joke-making which consists in smiling and "thinking back," the obvious way to explain a game of this type is to proceed "in reverse" and work from the goal backward.⁴

The attainment of the goal (52) is a certainty for the player who succeeds in bringing the sum to $46 = 52 - (1 + 5)$. In like manner, attaining 46 is assured as soon as $40 = 46 - (1 + 5)$, is reached. In this "House that Jack built" fashion we are forced to the conclusion that the player who begins with the number 4 is in a position to ensure reaching 52.

It is evident, therefore, that the key numbers (intermediate goals) form the arithmetic progression,

$$4, 10, \dots, 46.$$

The game is considerably improved in showmanship if the teacher concentrates on 40, 46, say, and is blithely indifferent to the earlier intermediate goals. Allowing the pupil first choice is consistent with this point of view.

If games on the order of this one and "think of a number" were to gain "social recognition" it might stimulate desire for a skill in the game of mathematics which is comparable with the virtuosity displayed in games which are much less useful.

⁴ It is evident that analytic (break-down) procedures of this sort are fundamental in all thinking. For example, it is a truism that memorizing synthetic (build-up) proofs in geometry has little educational value in comparison with mastering the analytic procedures which are required for problem solving.

ASPECTS OF PENICILLIN

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In 1929 Fleming,¹ of St. Mary's Hospital, London, wrote: "While working with Staphylococcic variants a number of culture-plates were set aside on the laboratory bench and examined from time to time. In the examination these plates were necessarily exposed to the air and they became contaminated with various micro-organisms. It was noticed that around a large colony of a contaminating mould the *Staphylococcus* colonies became transparent and were obviously undergoing lysis."

Fleming grew subcultures of the mold and found the filtrate made from the broth upon which the organism grew contained a powerful bactericidal agent for which he proposed the name "penicillin." The fungus was identified as a species of *Penicillium* by Fleming, and later was thought to be similar to *Penicillium notatum* Westling by Thom. This genus contains many of the common species infecting fruits, vegetables, cheeses and meats in our food markets.

Some have written that Fleming's discovery was purely accidental, but this is not entirely true. He was deeply interested during the whole of his career in the destruction of bacteria by leucocytes. In 1922, he described "lysozyme," a powerful anti-bacterial ferment occurring naturally in human tissues and secretions, in the whites of domestic eggs and elsewhere.

Fleming writes,² "It is certain that every bacteriologist has not once but many times had culture plates contaminated with moulds. It is also probable that some bacteriologists have noticed similar changes to those noted above, but that, in the absence of any special interest in naturally occurring antibacterial substances, the cultures have simply been discarded."

"It was, however, fortunate that, with the background I have briefly sketched, I was always on the lookout for new bacterial inhibitors, and when I noticed on a culture plate that the staphylococcal colonies in the neighborhood of a mould had faded away I was sufficiently interested in the antibacterial substance produced by the mould to pursue the subject."

¹ Fleming, Alexander. "On the Antibacterial Action of Cultures of a *Penicillium*, with Special Reference to Their Use in the Isolation of *B. Influenzae*," *Brit. Journ. Exp. Path.*, 10, pp. 226-236, June, 1929.

² Fleming, Alexander. "The Discovery of Penicillin," *Brit. Med. Bull.*, 2(1), 1944.

"Some, such as *B. coli* or *H. influenza*, were not inhibited at all, while others, such as *Staphylococcus*, *Streptococcus*, *Pneumonia*, *Gonococcus*, and the diphtheria bacillus would not grow anywhere near the penicillin. It was therefore clear that penicillin had a specific action on some bacteria and did not affect others. I have used penicillin constantly since 1929 for differential culture, but the use for practical therapeutic purposes remained in abeyance until the Oxford workers started their investigations."

For approximately ten years following Fleming's brilliant work, the study of mold antibiotics was left dormant, mainly because of the sudden appearance of the sulfa drugs. However, research was revived by British scientists more notably Florey and his colleagues, and subsequently many Americans turned their attention to the problem. So far all attempts to synthesize penicillin have presumably failed, but a highly purified natural product is now being manufactured in large quantities.

The production of penicillin is a difficult process influenced by a host of factors. In order to maintain high potency penicillin producing strains, the spores must be mixed with sand and soil, then desiccated under vacuum and stored at a temperature below freezing.

Routinely, a loopful of *Penicillium* spores from a stock culture are spread over a slant of solidified agar containing sporulation media. At the end of six days, the mold surface is covered with abundant green spores. Enough spores are produced to plant several two liter size bottles. These bottles contain approximately 300 cc. of media which is especially well adapted to enable *Penicillium* to produce a thick vegetative mat. The growth period varies from five to seven days, and the mature, blue-green mat is characterized by innumerable convolutions and the presence of yellow droplets (chrysogenin) on the surface. The penicillin which is exuded into the media during the growth period, evidently reaches its highest potency at from five to seven days and steadily declines thereafter. The optimum temperature for growth ranges from 72° to 74° Fahrenheit.

The above procedure is known as the "surface" growth method, while another, the tank or "submerged" growth, is becoming widely used. Here the mold grows and produces penicillin throughout a tank containing thousands of gallons of media. A different strain of *Penicillium notatum* is used in this method.

The temperature and amount of aeration must be kept constant for optimum growth.

Essentially, penicillin can be extracted by ether, amyl acetate and certain other organic solvents from an acidified aqueous solution. From the organic solvent the penicillin may be reextracted by shaking with water, maintaining the hydrogen ion concentration at neutrality. Charcoal may be used as a purifying agent, either to remove impurities from an organic solvent, or to adsorb the penicillin from an aqueous solution. In the latter case, the penicillin must be eluted from the charcoal by suitable means.

Penicillin is an acid, and the commercial product is a deep red-dish-orange fluid, yellow in dilute solution, with a faint but characteristic odor and a bitter taste. Potency is lost rapidly while in the liquid state; therefore penicillin is dried *in vacuo* as a sodium or calcium salt and stored as such.

Some of the bacteria highly susceptible to penicillin are *Streptococcus pyogenes* (causing pus formation and such a disease as puerperal fever), *Staphylococcus aureus* (causing bone disease and boils, etc.), both of which are important in war wounds, and *Streptococcus pneumoniae* (causing pneumonia). Medical journals are now reporting "miraculous" recoveries, especially from those ailments caused by the coccic bacteria, and in which the sulfa drugs had failed. The usually fatal staphylococcic and streptococcic septicemias show decided improvement within 24 hours after beginning treatment. Other susceptible organisms are *Corynebacterium diphtheriae* (causing diphtheria), *Clostridium welchii*, *septicum* and *oedematiens* (causing gas gangrene), *Neisseria gonorrhoeae* (causing gonorrhoea), *Neisseria meningitidis* (causing meningitis or spotted fever) and *Treponema pallidum* (causing syphilis).

Generally speaking, the Gram positive bacteria and Gram negative diplococci are sensitive to penicillin, whereas the Gram negative bacilli are restricted. Some much less sensitive are those causing typhoid fever and a form of food poisoning, while some, such as those causing plague, cholera, dysentery and tuberculosis, are quite insensitive. Malaria has not been controlled by penicillin.

It is now reported³ that in a mixture of normal cells and sar-

³ Corman, I. "Survival of Normal Cells in Penicillin Solution Lethal to Malignant Cells," *Science*, 99, p. 247, March, 1944.

coma cells of either mice or rats, penicillin kills the latter, but does not harm the normal cells. This only indicates the future possibilities of chemotherapeutic agents in the treatment of diseases other than those of bacterial origin. The limit of usefulness of penicillin in combating disease cannot be stated at this time, for it has been used in only the most critical cases.

In the concentrations usually used therapeutically, penicillin is apparently bacteriostatic rather than bactericidal in its action upon bacteria. In more concentrated form, it is germicidal and has been found superior to other germicides when its bactericidal effects were compared with its cytotoxic activity.

Two of the most important points concerning the pharmacological properties of penicillin are: (1) lack of toxicity to mice and other animals; (2) the white blood cells are unaffected by concentrations of penicillin some hundred times greater than that necessary to stop bacterial growth. It is important that penicillin has little effect on the white blood cells, or leucocytes, for it is to these that we owe a great deal of the capacity of the body to combat infection. Leucocytes ingest and kill the harmful germs which have gained entrance to the body. Also, in contrast to the sulfa drugs, penicillin is little affected by the number of bacteria present and is not inhibited by serum, blood, pus, or autolysed tissues or peptones. Any untoward complications noted during treatment with penicillin are transient, and no significantly harmful effects have as yet been noticed.

Because of the fact that *Penicillium notatum* is a rare species, and resembles so closely other members of the genus, it has been suggested that great precautions be taken by those who wish to culture *Penicillium* for therapeutic purposes.

Without sterile laboratory equipment, cultures of the safe *Penicillium* are apt to become contaminated with a species or strain that is highly toxic to the human body. Medical journals have also pointed out the danger of bacterial contaminants in topical dressings which are prepared by growing the mold in gauze pads.

The story of penicillin is one of the more popularized discoveries in medical history, and without doubt one of the most fortunate, for all other mold antibiotics brought to light to date are less active against bacteria, and more toxic to animal tissues than penicillin.

With pharmaceutical and biological laboratories bending all efforts to produce enough penicillin for our armed forces, it will

be some time before ample supplies will enable extensive research to determine its true and full value.

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ADVERTISING SOLID GEOMETRY WITH
SPECTACULAR TOPICS

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One of the speakers at a mathematics conference in Chicago closed with these words:

"I advise you teachers of mathematics, in your usual forty-five minute class period, having developed the new psychological attack, having stimulated the group, and motivated them, having provided for individual differences, and related the day's work to their life experiences, bearing in mind their I.Qs, their various social experiences—oh yes—and of course having taught something, do take a few minutes to advertise the subject."

Good advice, but how does one go about advertising Solid Geometry? I have developed for this purpose a series of what might be termed "spectacular" topics, spaced at appropriate intervals throughout the semester's work. By a "spectacular topic" is meant some topic that appeals to the pupils' imaginations and broadens their mathematical horizons and causes them to discuss the topic among themselves outside of class. This advertises the subject among the listeners who are not in the class and helps to build a class for the next semester. Where the semester is divided into five-week quarters as it is in Chicago, it is easy to include one such topic in each quarter's work.

In the first quarter, the spectacular topic is philosophy. By the time the pupil has reached solid geometry, he has had enough background and experience to be able to appreciate some of the philosophy underlying postulational reasoning. He can be led to appreciate the view that mathematics is a way of thinking in which one follows up the consequences of certain

fundamental assumptions. If he assumes that through a point P outside a line AB it is possible to have one and only one line parallel to AB, this assumption leads him to certain logical consequences; if he assumes that he may have more than one parallel to AB through P he is led thereby to a different set of consequences, while if he assumes that it is impossible to have any line through P parallel to AB he is led to still a third set of consequences. This leads to a discussion of non-Euclidean geometry, the geometry that seems best to fit interstellar space.

The pupil can be led to appreciate how practical this type of reasoning is. For example, the distinguished British physician, the late Lord Moynihan, believed that sculptured portraits of Alexander the Great made on his deathbed at Babylon show that he was dying of cerebro-spinal meningitis, probably acquired as an infection during his Babylonian campaign. If the doctors of that day had had the knowledge possessed by skillful modern surgeons (fundamental assumption), they would have drawn off some of the spinal fluid, administered a few drugs and saved the life of the great conqueror. The logical conclusion is that he might well have lived to consolidate his world empire under Greece; then Greece would have dominated the world later instead of Rome, and the Greek Orthodox Church might today be filling the part played in the world by the Roman Catholic Church.

The Declaration of Independence as Jefferson originally wrote it contained one clause in which he denounced the King and the British Government in regard to slavery and the slave trade. This clause was later omitted at the request of the delegates from South Carolina and Georgia. If this clause denouncing the slave trade had been allowed to stand (postulate), it would have led to the abolition of slavery at that time and the entire Civil War might have been prevented (conclusion). For further suggestions along this line the teacher is referred to Keyser's *Mathematics and the Question of Cosmic Mind*.

It is no reflection on the previous geometry teachers the pupil may have had to say that to most students beginning solid geometry a proof is just a proof, "merely that and nothing more." He does not know whether superposition was used in a given proof or *reductio ad absurdum*; he has no idea whether the author used analysis, synthesis, coincidence or exclusion. Some time can profitably be spent in differentiating between these various methods so that pupils can tell the difference between

them and recognize and use them. It can be shown how Marc Anthony used indirect reasoning at the funeral of Julius Caesar; how Burke used it in his famous speech on Conciliation; how Lincoln used it in speaking against slavery to audiences who favored the institution. President Roosevelt used indirect reasoning in his letter to Senator Barkley. Dale Carnegie's *How To Win Friends And Influence People* achieved the best-seller status by advocating the every-day use of indirect reasoning to smooth the way in human relations.

After these discussions the solid geometry students can "show off" in their English and history classes and thus bring in some more recruits for solid geometry.

In the second quarter the problem of the Duplication of the Cube can be introduced as the spectacular topic and tied up with those other two famous war-horses of geometry, the trisection of the general angle by straight-edge and compass and the squaring of the circle, explaining in a general way why they are impossible from the standpoint of postulational reasoning. In this quarter the topic of Duality may be introduced and run as a strand throughout the remainder of the semester. E.g., *line* and *point* may often be interchanged to get new statements, such as "Two points determine a line" and "Two lines determine a point except when the lines are parallel." Then if the reason for this added qualification is explained and if it is mentioned that later in trigonometry this qualification is removed, their curiosity about trigonometry is aroused. When they see that theorems on the sphere may be obtained from those on the circle by replacing *circle* by *sphere*, *circumference of circle* by *surface of sphere*, *line* by *plane*, etc., they gain an insight as to how theorems may be discovered and advances made in the subject.

After the work on pyramids in the third quarter is finished, the Great Pyramid of Egypt is introduced as a spectacular topic. It amazes pupils to learn that there were enough sixteen-ton stones used in building the pyramid that if they could be placed side by side in this country they would extend from New York to California and half way back to New York; that those ancient builders knew of the curvature of the earth and built the pyramid to conform with this curvature so that it has not split with age. It will amaze even the teacher to learn of the science and mathematics built into this structure. But what interests pupils most are the theories as to why it was built in the first place.

They are fascinated by the theory that it may have been constructed to preserve for future generations their best discoveries in science and mathematics in much the same way that the crypt in the mountains of Ogelthorpe, Georgia, preserves a record of modern times for the scientists of six thousand years hence. There is great discussion over the theory that the builders may have been a people with insight into the future and that in its interior measurements it contains many prophecies. This ties in with the Duke University experiments in telepathy and clairvoyance and the radio telepathy experiments.

In the fourth quarter, after proving the theorem concerning the angle-sum of a spherical triangle, we are led naturally to the question of whether space may be curved and hence whether all triangles may have an angle-sum greater than 180 degrees. This leads to mention of Einstein's work, the fascinating speculations concerning the fourth and higher dimensions, and brings to a fitting climax all we have previously considered concerning the philosophy of postulational reasoning.

It will be found that one topic of this nature each quarter is a refreshing revitalizer and inspires the pupil to attack the proofs and practical problems which comprise the great body of the course. But I can almost hear the reader asking, "How does one find time for all these things?" Even though the material and content of Solid Geometry is well established and well organized in most textbooks, there is still some material that can be omitted without being seriously missed. In this category would come the theorems about planes parallel to skew lines, the common perpendicular to skew lines, the volume of the frustum of a pyramid, the volume of a truncated prism, the area and volume of the frustum of a right circular cone, spheres inscribed and circumscribed about tetrahedrons, spherical sectors and segments and (except as examples of duality) isosceles spherical triangles and inequalities of sides and angles of spherical triangles. If this material is replaced by something which gives life to the course and interest to the pupils studying it the course will attract a larger number of students, and in that way more pupils will profit by the portions of the course which are retained.

As long as man dwells upon the globe his destiny is battle and he has to take the chances of war.

JUSTICE OLIVER WENDELL HOLMES

THE MODIFIED TRUE-FALSE ITEM APPLIED TO TESTING IN CHEMISTRY

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The true-false item is apparently held in low esteem by test experts engaged in the construction of standardized tests and has been severely criticised by many teachers and school administrators.

Since the advantages and disadvantages of this type of item have so admirably been discussed in the various textbooks on educational measurements and in many periodicals dealing with the field of education, the reader wishing additional information on this subject is referred to these sources.

McCluskey and Curtis,¹ Barton,² Bayless and Bedell,³ and Andruss⁴ have suggested various modifications of the true-false item. Lee and Symonds,⁵ in an article summarizing the researches dealing with objective test items, point out that the validity and reliability of true-false tests seem to be increased through the use of modified forms. Barton² found that the reliability of the cross-out true-false test is greater than the reliability of the unmodified true-false test in which the R-W formula is used.

Hovland and Eberhart⁶ discovered that the reliability of the true-false examination is increased by underscoring [italicizing] the critical part of the statement.

All forms of objective test items require careful construction. The modified true-false partial test in chemistry illustrated at the end of this article, combining the features of the true-false and completion (recall) items is no exception. Therefore, individuals wishing specific information concerning the rules for the construction of these objectives test items should consult the excellent text by Ruch.⁷ This source will provide essential

¹ McCluskey, H. Y. and Curtis, F. D. "A Modified Form of the True-False Test," *Journal of Educational Research* 14: 213-224, (October, 1926).

² Barton, W. A. "Improving the True-False Examination," *School and Society* 34: 544-546, (October 17, 1931).

³ Bayless, E. E. and Bedell, R. C. "A Study of Comparative Validity as Shown by a Group of Objective Tests," *Journal of Educational Research* 23: 8-16, (January, 1931).

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⁵ Lee, J. M. and Symonds, P. M. "New-Type or Objective Tests: A Summary of Recent Investigations," *The Journal of Educational Psychology* 24: 21-35, (January, 1933).

⁶ Hovland, C. I. and Eberhart, J. C. "A New Method of Increasing the Reliability of the True-False Test," *The Journal of Educational Psychology* 26: 388-394, (May, 1935).

⁷ Ruch, G. M. "The Objective or New Type Examination." Scott, Foresman and Company, 1929.

instructions which may be advantageously used in the construction of modified true-false test items.

The modified true-false partial test illustrated requires the italicizing of the key word, phrase, formula, or number. The student must, therefore, first decide whether the statement is true or false and enter the appropriate answer in Column I. If the statement has been marked false in Column I, the student is then required to place the word, phrase, formula, or number which will change the incorrect (false) statement to a correct (true) statement in Column II. Some teachers prefer to omit the italicizing of key words, phrases, formulae, and numbers in order that students may be required to recognize the particular segment which causes the statement (item) to be incorrect and then to make the correction in Column II.

The arrangement of the illustrated modified partial true-false test is suggested in this article for the purpose of facilitating correction and scoring. An extra duplicated copy of the test may be cut perpendicularly to the right of the item numbers by the teacher. After the correct answers have been filled in, the teacher is able to correct the entire test by the use of a SINGLE strip key. Through the use of the single strip key, the scoring time and labor may be somewhat reduced.

The modified true-false test may be scored by assigning one point to each blank correctly filled in. The total of the points secured constitutes the raw point score achieved by the student.

PARTIAL TEST ON SILICON

Directions: In Column I, the items listed below should be marked True or False. Use plus (+) to indicate True items and zero (0) to indicate False items. If, in column I, the item has been marked False, place in Column II the correct word, phrase, formula, or number replacing the incorrect italicized word, phrase, formula, or number.

Examples:

Column I	Column II
----------	-----------

+	
---	--

0	Combined
---	----------

Column I	Column II
----------	-----------

--	--

1. The valence of Silicon is *four*.
2. Silicon occurs in nature in the *free* state.
1. *Lavoisier* first isolated Silicon in the laboratory by heating Silicon Tetrachloride with Potassium.

- _____ 2. The name of the end product formed, in addition to Aluminum Oxide, in the reaction between Silicon Oxide and Aluminum is *Silicon*.
- _____ 3. The formula of the compound formed in the reaction between Silicon Dioxide and Carbon is CO_2 .
- _____ 4. Ferrosilicon is used in steel making for the purpose of removing *air bubbles*.
- _____ 5. H_2SiO_3 is the formula for meta-silicic acid.
- _____ 6. The name of the element formed in the reaction between Silicon and Sodium Hydroxide is *Hydrogen*.
- _____ 7. Na_2SiO_3 is the compound formed in the reaction between Silicon and Sodium Hydroxide.
- _____ 8. At high temperatures, Silicon combines with carbon to form C_2Si .
- _____ 9. Amorphous Silicon is obtained in the form of a *black powder*.
- _____ 10. *Metasilicic acid* is formed by the hydrolysis of Silicon Tetrachloride.
- _____ 11. SiF_4 is the gas formed in the reaction between Silicon Dioxide and Hydrofluoric Acid.
- _____ 12. *Orthosilicic acid* is converted by progressive dehydration into Silicon Dioxide.
- _____ 13. The formula for fluosilicic acid is H_2SiF_6 .
- _____ 14. When a strong solution of Sodium Hydroxide and sand are boiled under pressure, the formula of the Sodium compound formed is Na_4SiO_4 .

A QUESTIONNAIRE FOR THE CRITICISM AND EVALUATION OF A COLLEGE COURSE¹

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Throughout ten years of teaching biology and zoology to college students at two different institutions,² the writer has made it a practice to secure student appraisal of his courses at the end of each term. At first the students were simply asked to write down points of criticism of the course, and to offer suggestions for making improvements in it. Many students, however, would think of only a few points, and all students would not express an opinion on the same subjects. Many would undoubtedly have contributed more specific criticisms if certain topics had been brought to mind. In order to poll opinion on a number of items and to get the reactions of the entire group on the same topics, a questionnaire was devised to which each student was asked to respond at the end of the course. The questionnaire had the advantage of keeping the opinions anonymous for a student could answer most of the questions by simply making check-marks. However, space was provided for additional remarks for those who wished to make them. Students were asked not to sign their names in order that frank answers might be submitted without fear on the part of the students, in order that "apple polishing" be discouraged, and in order that no personal feelings on the part of the instructor be aroused. The questionnaire was first composed in terms of the collected items mentioned by various students during the first few years when the informal type of criticism was requested. Two revisions of the original questionnaire were made in order to clarify some of the statements and to include additional items later brought to attention. The section on evaluation was added most recently and was compiled from comments contributed during the first several years of using the questionnaire.

At the time the questionnaire is first given out, a careful explanation of both content and purpose is made to the students. A guarantee is made that the opinions will not be compiled nor the comments read until the students' final grades in the course

¹ Acknowledgment is made to Dr. A. W. Stewart, Dr. W. L. Garnett, and Dr. H. A. Cunningham of the Departments of Education, English, and Biology, respectively of Kent State University for suggestions and criticisms in revising the questionnaire and preparing the manuscript.

² The University of Illinois and Kent State University.

have been officially recorded. Students have been very cooperative and many demonstrate their eagerness to express an opinion on certain points and to make suggestions which in some cases have been on their minds for some time. During the time the writer has used his questionnaire, he has found that all of his students take the matter very seriously and offer some excellent criticisms and suggestions. Freshmen are the most critical and pointed in their statements.

The writer has found that such a questionnaire is particularly helpful to the instructor after offering a new course or a reorganized one. After teaching the same course for several years and making adjustments according to the constructive criticisms offered by the students, the questionnaire has little to offer, the results being remarkably uniform and the reactions usually favorable. After teaching a new or reorganized course for the first time, however, the results of the questionnaire are often surprising.

The interpretation of the results is not always easy. When many students make the same criticism, the instructor can be reasonably sure that a weak spot has been uncovered. However, the number of voters on any item is not necessarily a good guide. Probably some will answer without much careful thought, while others will make a searching study of the questions. A keen student might be alive to a certain weakness not observed by the others and would thus be out-voted. Because the ballots are anonymous, the instructor cannot evaluate the answers in terms of the ability and alertness of individual students. Likewise, of course, a criticism might be made by a student whose judgment might not be considered very seriously if its authorship were known. Many suggestions can be dispensed with because they are impractical or have been previously tried and proved to be unsuccessful. Also, some students have a tendency to suggest that the course include more of everything or of many things without indicating that there should be less of something else in order to maintain a balance in the time allotted to the study.

The writer has on several occasions changed the textbook of a course because the one used was considered unsatisfactory by the majority of students. On the other hand, several texts have been retained over a number of years because of overwhelming student approval as well as my own opinion favoring such an adoption. I have introduced short weekly quizzes in all of my undergraduate courses because of their demonstrated popularity

in those courses in which I first used them. Certain field trips which were not as successful as others were replaced by more satisfactory ones. It has been interesting to learn that year after year certain field trips have proved to be the most profitable ones in the opinion of many students. In one instance, a formerly required set of drawings was eliminated from a course because students believed that in this particular case, making them was a mechanical task which contributed little to their understanding of the subject and that the time would be better utilized on further work with the actual laboratory materials. Practical tests have replaced the drawings. These are a few of the advantages gained through using the questionnaire.

Little does an instructor realize his faults, the weaknesses of his teaching, and the student opinions of the course until he actually takes a census of student appraisal. At the same time he often discovers how successful he has been with certain aspects of his teaching. While students frequently complain outside of the class-room, their complaints are not effective until they are brought to the attention of the instructor. And similarly, their praise! Students are very critical of the textbooks which they have been required to purchase. They are very sensitive about such matters as unannounced quizzes, examination questions based on material not thoroughly studied in the course, and of the instructor's responsibility to the students. Also, they are very appreciative of fair examinations, frequent quizzes over recently studied material, individual attention in class, and of the assistance given when they face a difficult problem in the laboratory. They like a good sense of humor on the part of the instructor, but they also want to preserve the dignity befitting a college class-room. They are quick to spot dull or unsuccessfully developed topics, and to recommend further treatment of topics which may have been slighted. In the last analysis, the success of any course is determined by what it gives to the individual student.

The questionnaire offered here was devised especially for courses in the field of biology, but could easily be modified for use in other science courses. It could be adjusted for use in other courses of study, and also for other levels of our educational system.

QUESTIONNAIRE FOR CRITICISM AND EVALUATION OF COURSE OF STUDY

Course No. _____ Name of Course _____ Date _____

Check appropriate items and check as many as you can.

Text:

Excellent; Good; Fair; Poor;
 Continue as text; Discontinue;
 Assignments too long; Too short; Proper length;
 Too much additional reference reading; Too little; Right
 amount;
 Comments:

Lectures:

Too many; Too few; Right number;
 Too long; Too short; Right length;
 Too fast; Too slow; Right speed;
 Too much time spent on (name topic)
 Too little time spent on (name topic)
 Cover too much; Cover too little; Right coverage;
 Too many visual aids; Not enough visual aids;
 Right amount; Unsuccessful visual aids (name)
 Lectures difficult to hear; Difficult to follow;
 Demonstration materials difficult to see; Not difficult to see
;
 Comments:

Lab:

Too many hours; Too few hours; Right amount;
 More supervision desirable; Less supervision desirable;
 Enough supervision;
 Lab. periods too long; Too short; Correct length;
 Comments:

Field Trips:

Too many; Too few; Right number;
 More supervision desirable; Less supervision desirable;
 Enough supervision; Too long; Too short;
 Proper length;
 Which one was most enjoyable? (name)
 Least enjoyable? (name)
 Which one contributed most to your understanding? (name)
 Which one contributed the least? (name)
 Would you recommend supplementary trips? Where?
 Comments:

Written Quizzes:

Too many; Too few; Right number;
 Too long; Too short; Right length

Too many questions; Too few; Right number;
 Cover too much material; Too little; Right amount
;
 Comments:

Exams:

Too many; Too few; Right number;
 Too long; Too short; Right length;
 Too many questions; Too few; Right number;
 Cover too much material; Too little; Right Amount
;
 Too specific; Too general; Satisfactory;
 More objective questions desirable; More discussion questions
 desirable; Satisfactory balance;
 Comments:

Class Discussion:

Too much time spent on; Too little time; Right amount
;
 Too often; Too infrequently; Often enough;
 Not enough student participation; Too much student participa-
 tion;
 Class discussions were profitable; Not profitable;
 Did not feel free to ask questions; Did feel free to do so;
 Comments:

Requirements:

Course requires too much time; Not enough time; Proper
 amount;
 Course too difficult; Not difficult enough; Satisfactory
;
 Course should have more prerequisites;
 What prerequisites, if any?
 Credit should be increased; Decreased;
 Class hours should be increased; Decreased; Satisfactory
;
 Comments:

Evaluation:

	Yes	No
In your opinion did the course reach its stated objectives? . .		
Was the course worthwhile to you?		
Will it have any practical value to you?		
Has it opened new fields of thought for you?		
Has it broadened your outlook?		
Was the work stimulating?		
Did you find the study more interesting than you anticipated?		

Will you continue an active interest in the subject?.....
Did your interest begin to lag before the end of the course? If
so, approximately when did interest begin to drop?.....

What in your opinion was the greatest weakness of the course?

In what ways could the course be made of greater value?

General criticism, suggestions, and comments:

SOME MISCONCEPTIONS CONCERNING FORCE AND ACCELERATION

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Much attention is currently being given to the physiological effects of the high speeds and accelerations undergone by airplane pilots, particularly those of fighter planes and dive bombers. In some of the discussions of these effects there is confusion in the definition and use of such concepts as that of acceleration. Teachers of science, and particularly of physics, ought to present to their students an accurate, even though elementary, discussion of these ideas. Only in this way can one hope to dispel some of the fog that often surrounds such a phrase as "a 5g pull-out."

In the original horse-and-buggy days it was commonly supposed that high speed in itself was dangerous. A speed even as low as 10 mi/hr, such as was attainable by early steam locomotives, was feared to be impossible for the body to bear. When the fallacy of this prediction was made evident by experience, it was still felt that really high speeds would be fatal, if for no other reason than that it would be impossible to breathe. This error, too, was corrected by experiment, when delayed parachute drops were made from great heights; even after the parachutist had attained his terminal speed—more than 100 mi/hr—he was still not only conscious but quite able to pull the rip cord of his parachute.

On the other hand, there is no question about the danger of too high acceleration, whether positive or negative. A pedestrian struck by an automobile is subjected to a positive acceleration that he cannot withstand; when the car swerves into a telephone pole, both car and occupants undergo negative accelerations the effects of which may be disastrous.

It is in an attempt to describe such phenomena quantitatively

that confusion sometimes arises; it frequently manifests itself in a failure to distinguish between an acceleration and the force that produces it. As is well known, the first two of Newton's laws of motion can be expressed most briefly by the equation

$$f = ma, \quad (1)$$

in which a is the acceleration resulting from the application of a force f to a body of mass m ; thus for an object of constant mass the acceleration is proportional to the force producing it. If the accelerating force is the weight of the body—the force with which the earth attracts it—then the resulting acceleration is g , the acceleration due to gravity. Equation (1) then takes the special form

$$w = mg, \quad (2)$$

where w is the weight of the body. Equation (2) is frequently solved for m and the result substituted in Eq. (1), giving

$$f = \frac{w}{g}a. \quad (3)$$

Herein arises, at least in part, the wide-spread confusion between weight and mass, which it is not our purpose to discuss. Our present essential point is this: if the mass of a body is constant, a force applied to it always produces an acceleration, which is in the direction of the force; and conversely, an acceleration is the result of a force, which is in the direction of the acceleration.

To the immediate question, what is acceleration? the answer is, *time-rate* of change of velocity. Since velocity is a vector quantity, a change in it may consist of a change in its magnitude, or in its direction, or in both, and this change occurs in an interval of time. It is the fact that a body which is undergoing a change in the direction of its motion is undergoing acceleration, and hence is being acted upon by a force, that seems to be hard for beginners to understand. The familiar illustration is that of a stone whirled with constant speed in a circle at the end of a string. The direction of motion of the stone is constantly being changed; it is therefore undergoing an acceleration that is constant in magnitude but continuously changing in direction; the necessary force is provided by the pull of the string, and it is a centripetal—a center-seeking—force, the magnitude of which is just that required to keep the stone in the circle with-

out changing its speed. The necessary force becomes larger if the speed of the stone increases, or if the string is shortened, because then the rate at which the velocity is changing is greater. If the string is unable to supply this increased force it breaks; the stone is then under no compulsion to change its direction and does not do so. (In an elementary discussion, it may not be necessary to point out that in fact there is a tangential component of the tension in the string, required to overcome friction.)

The acceleration a of a body moving with constant angular speed in a circle is v^2/r , where v is the linear speed of the body and r is the radius of the circle in which it moves. The centripetal force required to bring about this acceleration is, in view of Eq. (1) or (2),

$$f = \frac{mv^2}{r} \quad \text{or} \quad f = \frac{w}{g} \cdot \frac{v^2}{r} \quad (4)$$

This is the force that must be applied to an airplane to make it turn in a circle or come out of a power dive; it is also the force that makes the pilot turn in the same path that the airplane follows. On the airplane it is exerted by the air; on the pilot it is exerted by the airplane.

The following quotation¹ is from a recent discussion of aviation biology.

If a pilot pulls his plane up suddenly when traveling at high speed there will be a resultant centripetal force acting in the direction from head to feet. This is referred to as positive acceleration. If the pilot suddenly turns his plane downward there will be a resultant centripetal force acting in the direction from feet to head. This is known as negative acceleration. The force exerted will depend on the speed and the radius of the curved path of flight. This force is expressed as a multiple of the normal force of gravitation or G and can be determined by the equation a (accel.) = $V^2/32.2r$, in which V is the velocity in feet per second, and r is the radius of the turn in feet. Thus if a pilot weighing 180 pounds at a normal gravitational force ($1G$) is traveling at a speed of 300 miles per hour and turns in a radius of 2,700 feet—a force of $2.2G$ is exerted on the pilot. This force would be 396 pounds (2.2×180). All the tissues and body fluids remain correspondingly heavy as long as the high velocity flight in a curve continues. If a force of $7G$ is attained a pilot weighing 180 pounds would be subjected to a force of 1,260 pounds. . . .

This quotation exhibits several misconceptions. The first sentence is illogical; the centripetal force does not come about because the pilot pulls his plane up; its existence is necessary in order that the direction of the plane may be changed. What the

¹ Krasno, Louis R. "Aviation Biology" *SCHOOL SCIENCE AND MATHEMATICS* Vol. XLIV No. 385, May 1944. pp. 393-397.

pilot actually does is dispose the control surfaces of his plane so that the direction of the force exerted by the air on the plane is such as to make it move upward. Moreover, if the pilot is sitting erect in the plane, the centripetal force is obviously not "in the direction from head to feet," but in the opposite direction. As a later paragraph shows, the author of the statement has in mind the fact that in a sharp turn made at high speed the pilot may temporarily become blind or lose consciousness—the effect called a "blackout." The reason is lack of blood in the brain, but this lack is brought about not by a force on the blood drawing it away from the brain but by a force on the brain pushing the latter away from the blood. The force exerted on the blood by other parts of the body is not sufficient to make it follow the same path that the brain takes. Just the same sort of thing causes accidents at curves on slippery roads; the force exerted by the road on the car is insufficient to push the car around the curve and the road runs out from under the car; the latter merely "continues in its state of uniform motion in a straight line." Similarly, mud is "thrown off" from a rapidly rotating wheel not because of a centrifugal—a center-fleeing—force acting on the mud but because of the lack of enough centripetal force to hold the mud in the circle. Thus, in the fifth sentence of the quotation the word "exerted" should be replaced by the word "required."

The most important misconception in the foregoing quotation obviously is the implication that force and acceleration are the same thing. The acceleration undergone by the pilot under the conditions given is about 72 ft/sec^2 , and this is about $2.2g$, where g , the acceleration due to gravity,² is 32.2 ft/sec^2 . The force that the airplane must exert on the 180-lb pilot to give him this acceleration is 396 lb, calculated by writing Eq. (3) in the form

$$f = w(a/g).$$

This is a larger force than the seat of the airplane exerts on the pilot during level flight and the feelings of the pilot are correspondingly different. He *feels* as if he were much heavier than usual, although of course both his weight and his mass are unchanged. If the last sentence quoted began "if an acceleration of $7g$ is attained . . ." it would be correct, for the pilot is sub-

² It is customary to use the symbol g for the acceleration due to gravity and G for the constant of proportionality in the Newtonian law of universal gravitation.

jected to the great force mentioned if he attains this acceleration.

Finally, the equation quoted—namely, $a = V^2/32.2r$ —is dimensionally incorrect, since the right-hand member is dimensionless, whereas the dimensions of acceleration are length divided by the square of time. What the author of the statement doubtless intended is that the acceleration be measured in units of $1g$; this is of course a valid procedure and one that is useful and convenient for expressing large accelerations, such as those of shell fired from guns, or for comparing an acceleration with that of a freely falling body. With this unit, however, the equation must be written

$$\frac{a}{g} = \frac{v^2}{gr},$$

which is dimensionally correct.

AMERICAN EDUCATION WEEK 1944

"Education for New Tasks" is the theme for the twenty-fourth annual observance of American Education Week.

The United States is engaged in the greatest war in history. Before us loom the tasks of the postwar years which only an educated citizenry can hope to master. Such times require a great public school system, excelling by far anything that we have yet accomplished in the education of our children, youth, and adults.

Education has made and is making an indispensable contribution to the winning of the war. Its role in the peace will be equally significant if the American people fully understand the potential power of education.

How can we win the peace? How can we maintain full employment? How can we combat intolerance? How can we conserve and improve our human resources? There are many factors in the solution of these momentous issues that will face the nation in the postwar years, but universal and adequate education of all the people is the basic ingredient of every sensible prescription for these problems.

We spare no expense to get people ready to win a war. Why? Because we know that only a trained people can win. Public sentiment would not tolerate for a moment any proposal to send American boys into battle without the best of training under the best instructors and with the best equipment that money can buy. Shall we do less to help our young people win the battles of the peace to come?

American Education Week is an opportunity to interpret the role of education in the postwar years as well as the present contribution of the schools to the war effort.

The NEA has prepared materials to assist local schools in the observance of American Education Week such as a poster, leaflets, a sticker, a manual, plays, a movie trailer, radio scripts, newspaper advertising mats, and other materials. Address the National Education Association, 1201 Sixteenth Street, N. W., Washington 6, D. C. for an order form and further information.

BOOK-LENGTH BIOGRAPHIES OF CHEMISTS

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No one should be recognized a master in any subject who does not know at least the outline of its history. Of course it would be foolish to expect him to have any deep historical knowledge, but he should know the main landmarks and the leading personalities—he should be acquainted with his scientific ancestors.

This is almost a moral obligation. We might compare it to the obligation for any educated citizen to know the history of his country. The obligation is of the same kind and of the same order. . . . For a physicist not to be sufficiently familiar with Galileo and Newton is just as shocking as for an American not to know Washington and Lincoln.

These are the words of Dr. George Sarton,¹ the noted historian of science. A decade ago they motivated the present writer to take up what has proved to be a most satisfying and profitable avocation: to seek out, to read, and to record:

I. All *book-length* biographies (individual and collected) in English of physicists, astronomers, mathematicians, chemists, metallurgists and engineers.

II. All of the more important writings in English on the historical development of electrophysics and electrical engineering and on the lives of noted electrophysicists and electrical engineers.

Literal accomplishment of this program is, of course, virtually impossible: but it can be carried to a high degree of completion. And now that the hunt for material has encompassed search of (i) complete files of the consequential serial publications in English devoted to physics or to electrical engineering; (ii) the stacks and the card catalogs of many of the important public, university, and technical libraries located in the East and Middle West; (iii) the accumulated catalogs of the principal publishers of technical and scientific books; (iv) the lists of offerings, over a decade, of the larger dealers in used and rare technical and scientific works; (v) much relevant miscellaneous bibliographical material—book review journals, printed catalogs of private libraries, and kindred aids—it is believed that much the greater part of the more worthwhile material has been located and read.

¹ G. Sarton, *The history of science and the new humanism* (Harvard University Press, Cambridge, 1936), pp. 43–44.

In such thought it seems desirable that this material now be made available to those similarly interested.

At present the file devoted to items of category I contains some 800 titles; that devoted to category II, some 1,500 titles. The bibliography below comprises the items of I apposite to chemists. Elsewhere are to appear separate bibliographies on physicists and astronomers,² on mathematicians, and on metallurgists and engineers; and the complete bibliography of some 1,500 titles on the historical development of electrophysics and electrical engineering and on the lives and work of the more noted of those who labored in these domains.

The writer will not attempt here to discuss what is to be gained through reading one, several, or many of the titles listed. His own views on the use of biographical material as a tool in teaching have been presented elsewhere.³ Again in several books^{1,4,5} and in numerous papers published in *Isis* and in other journals, Doctor Sarton has discussed in detail the special values of the study of the history of science, mathematics and technology, and of the use of biographical material therein. Finally, in that they who undertake to read of the books listed below cannot fail to gain therefrom a considerable knowledge of the origins and developments of various branches of chemistry, it is of interest to recall a pertinent remark of Ernest Mach:⁶

They that know the entire course of the development of science will, as a matter of course, judge more freely and more correctly of the significance of any present scientific movement than they, who limited in their views to the age in which their own lives have been spent, contemplate merely the momentary trend that the course of intellectual events takes at the present moment.

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* The phrase, "among others," signifies that these latter are not chemists.

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- W. Haynes, *Chemical pioneers, the founders of the American chemical industry* (D. Van Nostrand Co., Inc., New York, 1939), 288 pp. Winthrop, Rosengarten, Kalbfeisch, Cochrane, Mapes, Grasselli, Lewis, Warner, Mallinckrodt, Klipstein, Dennis, Hasslacher, Queeny, Washburn, Dow, Bower, E. I. du Pont de Nemours, Frasch, Harrison, Hazard, Hooker, Jayne, Merck, Nichols, Pfizer, Wetherill, White.
- M. Holland and H. F. Pringle, *Industrial explorers* (Harper Bros., London

- and New York, 1928), 347 pp. Whitney, Baekeland, W. D. Bigelow, H. K. Moore, Mees, E. C. Sullivan, H. E. Barnard, C. L. Reese.
- E. J. Holmyard, *The great chemists* (Methuen and Co., London, ed. 3, 1929), 138 pp. Bacon, Paracelsus, Boyle, Stahl, Priestley, Lavoisier, Dalton, Avogadro, Davy, Liebig, Kekulé, Pasteur, Arrhenius, Mendeléeff, Ramsay.
- E. J. Holmyard, *Makers of chemistry* (Clarendon Press, Oxford, 1931), 314 pp. Discusses several scores of famous chemists.
- C. J. Hylander, *American scientists* (The Macmillan Co., New York, 1935), 186 pp. Langmuir, Urey among others.
- B. Jaffe, *Crucibles: the lives and achievements of the great chemists* (Simon and Schuster, New York, 1930), 377 pp. Trevisan, Paracelsus, Becker, Priestley, Cavendish, Lavoisier, Dalton, Berzelius, Avogadro, Woehler, Mendeléeff, Arrhenius, Curie, Thomson, Moseley, Langmuir.
- H. B. Jones, *The Royal Institution, its founders and its first professors* (Longmans, Green, and Co., London, 1871), 431 pp. Garnett, Davy among others.
- F. Kaplan, *Nobel prize winners: charts, indexes, sketches* (Nobelle Publishing Co., Chicago, ed. 2, 1941).
- J. Kendall, *Young chemists and great discoveries* (G. Bell and Sons, Ltd., London, 1939), 272 pp. Davy, Faraday, Perkin, Couper, Kekulé, Pasteur, Van't Hoff, Ostwald, Mendeléeff, Moseley, Curie, Hall, Langmuir, Playfair, and others less renowned.
- D. H. Killeffer, *Eminent American chemists: a collection of portraits of eminent Americans in the field of chemistry from the earliest days of the republic to the present, together with short sketches of the work of each* (The author, New York, 1924), 70 pp.
- P. Lenard, *Great men of science; a history of scientific progress*, tr. by H. S. Hatfield (The Macmillan Co., New York, 1934), 389 pp. Brief sketches of several hundred scientists including many chemists.
- J. N. Leonard, *Crusaders of chemistry, six makers of the modern world* (Doubleday, Doran and Co., Inc., New York, 1930), 307 pp. Priestley, Cavendish, Lavoisier, Flamel, Bacon, Paracelsus, Boyle.
- D. McKie and N. H. de V. Heathcote, *The discovery of specific and latent heats* [The work of Black and Wilcke] (E. Arnold and Co., London, 1935), 155 pp.
- A. N. Meldrum, *Avogadro and Dalton. The standing in chemistry of their hypotheses* (Aberdeen University Studies No. 10, Aberdeen, 1904), 113 pp. *Not so much biographical as a critical study of their scientific work.*
- M. M. P. Muir, *Heroes of science; chemists* (Society for Promoting Christian Knowledge, London; E. and J. B. Young and Co., New York, 1883), 332 pp.
- R. H. Murray, *Science and scientists in the nineteenth century* (The Sheldon Press, London; Macmillan Co., Toronto and New York, 1925), 450 pp. Pasteur among others. A uniquely written work.
- J. Munro, *Pioneers of electricity: or, short lives of great electricians* (The

- Religious Tract Society, London, 1890), 256 pp. Davy, Faraday among others.
- I. Nechaev, *Chemical elements, the fascinating story of their discovery and of the famous scientists who discovered them*, tr. by B. Kinkead (Coward-McCann, Inc., New York, 1942), 223 pp. Scheele, Davy, Bunsen, Kirchoff, Mendeleyev, Ramsay, Rayleigh, the Curies.
- D. O'Raghallaigh, *Three centuries of Irish chemists*, ed. by D. O'Raghallaigh (Cork University Press, Cork, 1941), 30 pp.
- W. Ramsay, *Essays, biographical and chemical* (Constable and Co., Ltd., London, 1908), 256 pp. Boyle, Cavendish, Davy, Graham, Black, Berthelot among others.
- P. C. Ray, *Makers of modern chemistry* (Chuckervetty, Chatterjee and Co., Calcutta, 1925), 110 pp.
- E. Roberts, *Famous chemists* (George Unwin and Co., Ltd., London; The Macmillan Co., New York, 1911), 247 pp. Stahl, Boyle, Black, Cavendish, Priestley, Scheele, Lavoisier, Berthollet, Dalton, Davy, Gay-Lussac, Berzelius, Faraday, Dumas, Wohler, Liebig, Graham, Bunsen, Hofmann, Pasteur, Williamson, Frankland, Kekule, Mendeléeff, Perkin, V. Meyer.
- A. Schuster and A. E. Shipley, *Britain's heritage of science* (Constable and Co., Ltd., London, 1918), 334 pp. Brief sketches of scores of British scientists including many chemists.
- T. O. Sloane, *Liquid air and the liquefaction of gases: a practical work giving the entire history of the liquefaction of gases from the earliest times of achievement to the present day* (Norman W. Henley Publishing Co., New York, ed. 3, 1920), 349 pp. Faraday, Pictet, Cailletet, Wroblewski, Olszewski, Dewar, Tripler, Linde, Claude, Kammerlingh-Onnes. Chiefly biographical.
- E. E. Slosson, *Major prophets of today* (Little, Brown and Co., Boston, 1914), 299 pp. Ostwald among others.
- W. A. Tilden, *Famous chemists; the men and their work* (G. Routledge and Sons, London; E. P. Dutton and Co., New York, 1921), 296 pp. Boyle, Black, Priestley, Cavendish, Scheele, Lavoisier, Davy, Dalton, Gay-Lussac, Proust, Berzelius, Faraday, Avogadro, Cannizzaro, Liebig, Dumas, Frankland, Williamson, Mendeléeff, Crookes, Ramsay.
- H. Thomas and D. L. Thomas, *Living biographies of great scientists* (Garden City Publishing Co., Inc., Garden City, 1941), 314 pp. Lavoisier, Dalton, Faraday, Pasteur, the Curies, Banting among others.
- T. E. Thorpe, *Essays in historical chemistry* (Macmillan Co., London, 1894), 381 pp. Boyle, Priestley, Scheele, Cavendish, Lavoisier, Faraday, Graham, Wöhler, Kopp, Mendeléeff.
- E. R. Trattner, *Architects of ideas* (Carrick and Evans, New York, 1938); reissued as *The great theories of mankind, architects of ideas* (Blue Ribbon Books, New York, 1940). Dalton, Lavoisier, Pasteur among others.
- D. M. Turner, *Makers of science, electricity and magnetism* (Oxford University Press, Humphrey Milford, London, 1927), 184 pp. Priestley,

Cavendish, Davy, Faraday among others.

T. F. Van Wagenen, *Beacon lights of science: a survey of human achievement from the earliest recorded times* (Thomas Y. Crowell Co., New York, 1924), 444 pp.

A. E. Waite, *Lives of alchemystical philosophers, based on materials collected in 1815 and supplemented by recent researches* (George Redway, London, 1888), 315 pp. Sketches of 53 medieval alchemists and chemists.

J. J. Walsh, *Catholic churchmen in science: sketches of the lives of Catholic ecclesiastics who were among the great founders in science* (American Ecclesiastical Review, The Dolphin Press, Philadelphia, vol. 1, 1906; vol. 2, 1909; vol. 3, 1917). Vol. 1 encompasses "B. Valentine: founder of modern chemistry" and "Abbe Haüy, father of crystallography."

M. E. Weeks, *Discovery of the elements* (Journal of Chemical Education, Easton, ed. 4, 1939), 470 pp. Essentially biographical in content.

A. Williams-Ellis, *Men who found out: stories of great scientific discoveries* (G. Howe, Ltd., London, 1929; Coward-McCann, Inc., New York, 1930), 259 pp. Faraday, Pasteur, the Curies among others.

G. Wilson, *Great men of science: their lives and discoveries* (Garden City Publishing Company, Garden City, 1929), 397 pp. Faraday among others.

E. Yost, *Modern Americans in science and invention* (F. A. Stokes Co., Toronto and New York, 1941), 270 pp. Wiley, Carver, Baekeland, Cottrell, R. R. Williams, Truog among others.

T. Young, *Biographies of men of science*, vol. 2 of *Miscellaneous works of the late Thomas Young*, vols. 1 and 2 edited by G. Peacock, vol. 3 by J. Leitch (John Murray, London, 1855). Cavendish, Tennant, R. Watson, Fourcroy among others.

Leading American men of science, ed. by D. S. Jordan (Henry Holt and Co., New York, 1910), 471 pp. Silliman, Gibbs among others.

Memoirs of the distinguished men of science of Great Britain living in the years 1807-08, compiled by W. Walker (E. and F. N. Spon, London, 1864), 160 pp. Cavendish, Dalton, Davy, W. Henry, Rumford, Tennant, Watt, Wollaston, D. Rutherford, W. Allen among others.

Memorial lectures delivered before the Chemical Society, 1893-1900 (Gurney and Jackson, London, 1901), vol. 1 Stas, Kopp, Marignac, Hofmann, Helmholtz, L. Meyer, Pasteur, Kekulé, V. Meyer, Bunsen, Friedel, Nilsson.

Memorial lectures delivered before the Chemical Society, 1901-1913 (Gurney and Jackson, London, 1914). Vol. 2, 297 pp. Rammelsberg, Raoult, Wislicenus, Cleve, Gibbs, Mendeléeff, Thomson, Berthelot, Moissan, Cannizzaro, Becquerel, Van't Hoff, Landenburg.

Memorial lectures delivered before the Chemical Society, 1914-1932 (The Chemical Society, London, 1933), vol. 3, 180 pp. Fisher, Baeyer, Van der Waals, Onnes, Arrhenius, Richards, Wallach.

The Nobel prize-winners and the Nobel Foundation, 1901-1937, ed. by

T. W. MacCallum and S. Taylor (Central European Times Publishing Co., Zurich, 1918).

Three famous alchemists; Raymond Lully by A. E. Waite: Cornelius Agrippa by L. Spence: Theophrastus Paracelsus by W. P. Swainson (Rider and Co., London, 1939), 186 pp.

The world's great scientists, vol. 1 of *Home Study Circle Library* (Doubleday and McClure, New York, 1900), 399 pp. Dalton, Davy, Faraday among others.

EASTERN ASSOCIATION OF PHYSICS TEACHERS

ONE HUNDRED FIFTY-SEVENTH MEETING ANNUAL MEETING

Mechanic Arts High School, Boston, Massachusetts
Saturday, May 6, 1944

MORNING PROGRAM

Joint Session with The New England Biological Association and
The New England Association of Chemistry Teachers

- 9:45 Greetings: James W. Dyson, Mechanic Arts High School.
- 10:00 Address: The Army Method of Instruction, Captain John P. Dempsey, Chief of Visual Arts, Signal Corps, First Service Command.
- 10:45 Address: The Private School After the War, George H. Blackwell, Science Master, Groton School.
- 11:30 Address: "National Search for Scientific Talent," Dr. Harlow Shapely, President of Sigma Xi, Harvard College Observatory.
- 12:30 Luncheon.

AFTERNOON: PHYSICS PROGRAM

- 2:00 Address: Sundials, R. Newton Mayall, Harvard College Observatory.
- 2:45 Address: Pre-Driving Courses in High School, Inspector Eugene Fanning, Registry of Motor Vehicles.
- 3:00 Business Meeting—Election of Officers.

Officers

Louis R. Welch, *President*: English High School, Boston, Mass.
George H. Blackwell, *Vice-President*: Groton School, Groton, Mass.
Carl W. Staples, *Secretary*: High School, Chelsea, Mass.
Albert R. Clish, *Treasurer*: Belmont High School, Belmont, Mass.

BUSINESS MEETING

The following were elected to active membership:

John P. Lane, Phillips Academy, Andover, Mass.
Donald W. Goodnow, Auburn High School, Auburn, Mass.
Francis J. Rio, Senior High School, New Britain, Conn.
Paul E. Werner, Westover School, Middlebury, Conn.

The election of officers was supposed to be held at the afternoon meeting, but owing to the small attendance, the nominating committee did not report, and it was voted to postpone the election until the first meeting in the fall.

THE PRIVATE SCHOOL AFTER THE WAR

GEORGE H. BLACKWELL, *Science Master, Groton School*

Mr. Blackwell spoke on the readjustment to normal conditions in science curricula after the war.

NATIONAL SEARCH FOR SCIENTIFIC TALENT

DR. HARLOW SHAPELY

Dr. Shapely spoke regarding Science Service and the annual contests for pupils which it has been sponsoring. While these have not been held for a sufficient number of years to show any definite trends, it is believed that a few years more will give sufficient data from which to draw conclusions.

SUNDIALS

R. NEWTON MAYALL, *Harvard College Observatory*

Mr. Mayall, who is in charge of the Ernst Collection of Sundials at Harvard College Observatory gave a talk on the sundial, explaining the various types, and their history. His very interesting talk was profusely illustrated with lantern slides, as well as by some actual specimens. In the main his talk followed his article on "Know your Sundials" in *Sky and Telescope* Vol. II, No. 10, August, 1943, pages 3-6, to which the reader is referred.

Types of dials were listed as follows:

- | | |
|---------------------|---------------------|
| 1. Ordinary Types. | 2. Special Types. |
| Horizontal | Horizontal-vertical |
| Vertical | Armillary |
| Declining | Analemmatic |
| Reclining | Signal gun |
| Inclining | Conical |
| Declining-reclining | Concave |
| Declining-inclining | Convex. |
| Equatorial | |
| Polar | |
| Multiface | |

PRE-DRIVING COURSES IN HIGH SCHOOL

INSPECTOR EUGENE FANNING, *Registry of Motor Vehicles*

Mr. Fanning spoke of courses in pre-driving which had been interrupted by the war, yet the past year had shown more need than ever for such courses. This was caused by increased demand for more drivers.

It has been found that boys and girls of 16-24 years have the worst record for accidents. Their physical reactions are quick but they have not been taught to drive as they should be. There has been no thought for pre-training on the mechanism side.

The physical qualities of the driver should first be considered. Defective vision, tunnel-vision, night-blindness, and slow reaction time are defects of which drivers are often unaware until an accident happens.

Study courses should teach how to start, stop, and steer, but the instructor often fails to realize that the instrument can cause harm if not handled properly. The high school is overburdened. It is impossible to give adequate instruction by limiting to actual operation of the car. The problem comes afterwards as well in increased traffic on the highways.

The registry sponsors courses, and encourages conferences between the registry and the high schools. Any who are interested are invited to confer with the registry.

Mr. Fanning called on Mr. De Lano to explain what he had been doing with pre-driving classes. The latter explained that his classes began in evening schools with overhauling of cars, and later were modified by use of models of various parts of the automobile, such as are advertised by Welch and Co. These models, he said, worked very well and the pupils, especially the girls, liked them better. The idea of mechanical advantage gave a good starting point. They might begin with the steering wheel, or with the instrument on the board, teaching how they work. Then the jack, and how much it could lift. Starting thus in the physics class the pupils became interested. The relative amount of the year taken up by the automobile depended on the interest of the class.

Booklets on laws of driving, and a book called *Man and Motor Car* National Conservation Bureau, is obtainable at \$.50 each when 100 or more copies are purchased. These deal with the car, its construction, care, etc. It has questions and answers in the back. It is a real text-book, written by several contributors, experts in their lines.

This idea of the pre-driving course, Mr. Fanning said, should not be allowed to die because of the war.

WAR BOND MUSICAL SHOW BECOMES NATIONWIDE HIT

Since early Spring the new Treasury War Bond musical show "Figure It Out" has been produced in at least twelve states. In some instances it has been done simply with only 30 or 40 students during an assembly period, while other schools have made it an extravaganza for a full evening's entertainment with a cast of several hundred.

With catchy tunes and amusing dialogue "Figure It Out" dramatizes the high cost of living and how the individual can fight that rise through buying War Bonds and Stamps. Such songs as "Double Duty Dollar" and "I'm an Inflationary Dollar" give pertinent advice to the audience to save more.

That means that "Figure It Out" serves a double purpose. While it is providing real entertainment, it is bringing to the community the philosophy of the nation's War Finance program so that each citizen may "Figure It Out" for himself, and save accordingly.

Information about free materials for staging "Figure It Out" may be obtained from the Education Section, War Finance Division, Washington 25, D. C.

NOTES FROM A MATHEMATICS CLASSROOM

JOSEPH A. NYBERG

Hyde Park High School, Chicago, Illinois

83. Minimum Courses. Every school now provides for individual differences. If a pupil's past history and future prospects are such that the study of Latin and algebra would be a waste of time then he can enroll in a class in community civics or hair dressing. But trouble arises when the pupil's parents insist that Johnny be prepared for college and study algebra. "If Johnny were going to be just a mechanic, I would put him in a shop," says Johnny's father. "Mary can learn cooking at home," says Mrs. Jones. Hence each course, as well as the whole curricula, must be planned for individual differences. And so we have the so-called minimum courses.

Colleges are admirably suited to give differentiated and minimum courses; for example, one course in trigonometry for future engineers, another for the mathematically inclined, and another course for the general student. But the situation in a high school is different.

The program for individual differences was a boon to the small high school. If it could not provide different curricula, it could make Latin a study of Roman culture and English derivatives. Algebra could become mostly drawing of graphs and still be called algebra.

The teacher is not to be blamed for the results. The community insists that Johnny be in a class labeled algebra. The teacher cannot teach the usual algebra and then say that Johnny failed. The community insists that Johnny be stamped with the mark of success. The teacher will either do this or a more enlightened teacher will be in the classroom next year.

Various suggestions have been made. A pupil following the minimum course should get only the lowest passing mark. Such a policy will at least keep that pupil from standing near the head of the class when his four-year average is computed or be ahead of the pupil who does passing work in a non-minimum class. His class rank will then indicate to the college that admits him that he is not a brilliant pupil.

Second, in planning the daily work do not teach the minimum course. The teacher should teach as if he had never heard of minimum courses, as if such things never existed. Let Johnny learn what he can in a regularly conducted class. As a final mark

give him the lowest passing grade. Johnny will be satisfied, and it is unlikely that his parents will complain. Thereby the average pupils following the average course will not be penalized by Johnny's presence.

This policy is not dishonest if we are willing to say to Johnny: You learned little but it is not worth while for you to repeat the course. Johnny is not fooled; he knows he does not deserve the credit. Neither is there any danger that he will get the habit of expecting something for nothing; he knows that real life is different from school life. His out-of-school experiences teach him that on the baseball field and on his Saturday job, you either deliver the goods or take the consequences. Give Johnny his passing mark, but tell him why he is getting it. He should know that he has not fooled the teacher. Many of the objections to giving an undeserved passing grade are eliminated if the pupil is told *why* he is getting it.

If confronted with a choice between (1) teaching a minimum course and letting the pupils think they have learned the customary algebra, and (2) teaching a better than minimum course and giving credit to those who do not deserve it, I would choose the second.

84. Anticipating Future Fields. The teacher in the eighth grade includes work on solving $5x=30$ and $x+6=9$ to prepare the pupil for ninth grade work in algebra. The teacher in the ninth grade wants to include some trigonometry and geometry. The tenth grade teacher of geometry wants to include some solid geometry. The teacher of intermediate algebra wants to include some analytic geometry and derivatives. One would think that teachers were ranked socially according to the grade of the material they taught, and that each was striving for a higher social status. I dislike the entire policy, and my reason is not the fact that most of my experience has been with those of low I.Q.

When the pupil enters an algebra class he says, "Oh, we had algebra last year; I know all that." So he is careless about his work and then suddenly finds he does not know what the class is talking about. In the geometry class, the pupil uses theorems he has never proved but which he used in the algebra class. When he reaches trigonometry he "has had trigonometry." I wonder how the college instructor feels about students who "have had" analytics and calculus in high school.

Little is gained and much is lost by anticipating the future fields. The eighth grade teacher has not taught all there is in

arithmetic; the ninth grade teacher has not covered the field of algebra. This is not the same as insisting that each year's work be devoted to a single field. Instead of dragging the ninth grade work into the eighth, the process should be reversed: let the ninth grade work include some arithmetic. Let the intermediate algebra class involve some geometry; let the trigonometry class include some algebraic material (as illustrated in the next section) and let the solid geometry class include some algebra. The reason we do not do this is obvious: we do not dare to assume the pupils still know what they were taught.

85. Algebra in the Trigonometry Class. To derive the law of cosines, I draw the figure on the board and state the problem: Find a relation between $\cos A$ and the sides of the triangle.

Let h be the altitude from C , and x and y be the two segments on the side c . The figure will give us these equations:

$$x+y=c \quad x^2+h^2=b^2 \quad y^2+h^2=a^2 \quad x=b \cos A.$$

Our problem now is to juggle these equations until we find one that involves a , b , c , and $\cos A$.

I could be learned and say that this is a set of four equations (some of which are quadratic) in four unknowns and three parameters. Such a remark makes the class think that we are about to invade Einstein's territory. Here we have an example of using algebra in the trigonometry class, and the method is decidedly not the method of any textbook. No author would dare to assume that the pupil has learned any algebra in the algebra class; too many of the class may have followed minimum courses. Usually it is advisable to postpone trigonometry for a few days, and review the solutions of sets of equations in several unknowns.

Again, suppose we have inscribed a circle in a triangle. In a straight forward manner the text proves that the distance from A to the point of tangency is $s-a$. The derivation involves some clever substitutions the source of which is never revealed. But if the class is not scared to use some algebra, it writes

$$x+y=c, \quad y+z=a, \quad z+x=b$$

and solves a set of three equations in three unknowns. And if the class cannot handle the necessary algebra, then *there* is the right spot for teaching algebra.

86. Learning Several Methods. Last year, in section 45, I expressed disapproval of the notion that one method of solving a problem is sufficient. There are good reasons why three ways of

solving quadratics should be studied, the principal reason being that the pupil is afforded an opportunity to use judgment in selecting a method. The same arguments apply to solving sets of two or three equations. Sets of three equations are not usually a part of ninth grade algebra, but should be included in intermediate algebra. Unfortunately, many courses of study for the latter make slight mention of these sets or consider them as supplementary.

To encourage thinking, the pupil should be confronted with a choice. There are two ways of simplifying a complex fraction, multiplying the numerator and denominator, and changing each term to a fraction, and so on. Some day the pupils should be given a dozen such fractions and the question raised: When is one method better than the other? The pupils in minimum courses learn one method; for the other pupils the simplification of a fraction is less important than the practice in analyzing a situation. One might almost say that those in the minimum course learn algebra, and the others learn how to think.

Consider the fraction:

$$\frac{a^2+5ab+6b^2}{a^2+3ab}$$

If the fraction occurs early in the year, the pupil knows this is a problem in long division; but later in the year, the numerator and denominator should be factored. As some pupils say, "I can't work the problem until you tell me what page it is on." We can make a "thinking problem" of this by asking:

What should be done to this fraction if you wished to add it to $\frac{3b}{a}$? if you wished to add it to $\frac{b^2}{a^2+3ab}$? if you wished to find its

value for $a=3$, $b=-4$? if it were a value of x to be checked in a

literal equation? if it were to be multiplied by $\frac{a^2+3ab}{b}$?

Those who would teach algebra, geometry, trigonometry, and analytics together, would have a splendid argument for their case if problems could be found which involved all these fields, thereby requiring the pupil to exercise judgment in selecting the best method. But are there such problems in the elementary fields?

PROBLEM DEPARTMENT

CONDUCTED BY G. H. JAMISON

State Teachers College, Kirksville, Mo.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to their authors. Each solution, or proposed problem, sent to the Editor should have the author's name introducing the problem or solution as on the following pages.

The editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to G. H. Jamison, State Teachers College, Kirksville, Missouri.

SOLUTIONS AND PROBLEMS

Note. Persons sending in solutions and submitting problems for solutions should observe the following instructions.

1. Drawings in India ink should be on a separate page from the solution.

2. Give the solution to the problem which you propose if you have one and also the source and any known references to it.

3. In general when several solutions are correct, the ones submitted in the best form will be used.

EDITOR'S NOTE:

It is hoped to issue the Journal three weeks earlier than in the past. The problem copy, which was sent to the printer the first of the month, will now be sent about the seventh of the preceding month. Contributors please note and send in copy three weeks earlier.

LATE SOLUTIONS

1867. *Milton Schifffenbauer, New York.*

1868, 71, 59, 60. *Hugo Brandt, Chicago.*

1867. *Bob Moore, Kirksville, Mo.*

A LATE SOLUTION

1870. *Proposed by Flora Mooney, Tecumseh, Michigan.*

If the sums of the opposite sides of a quadrilateral are equal in pairs, the quadrilateral may be circumscribed about a circle.

Solution by M. Kirk, West Chester, Pa.

We are given that

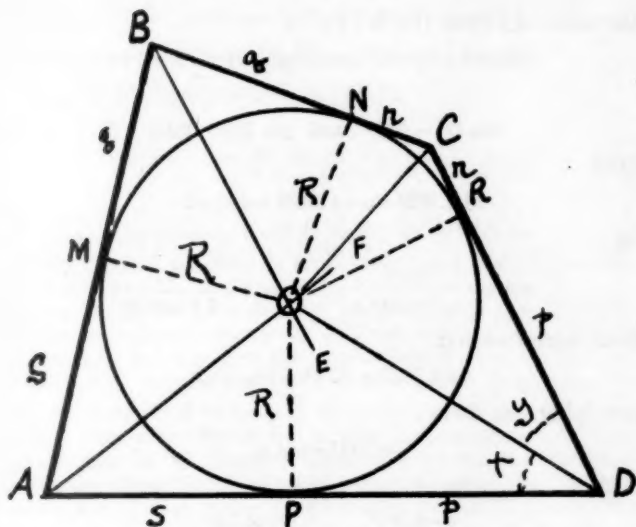
$$AB + CD = BC + AD.$$

Now draw BE bisecting $\angle B$, and AF bisecting $\angle A$. Let O be the point where AF and BE meet.

Then $OP = OM = ON = R$, as designated in figure.

Draw $CR = CN = r$. Then $DP = DR = P$.

From right $\triangle OPD$,



$$\cos x = \frac{p}{\sqrt{R^2 + p^2}} \quad (1)$$

From $\triangle OCD$, using law of cosines,

$$\overline{OC}^2 = R^2 + r^2 = R^2 + p^2 + (R + p)^2 - 2(R + p)\sqrt{R^2 + p^2} \cos y.$$

After simplification

$$\cos y = \frac{p}{\sqrt{R^2 + p^2}} \quad (2)$$

From (1) and (2) $|x| = |y|$. Hence

$$\triangle ORD = \triangle OPD \text{ and } OR = R \text{ and } OR \perp CD.$$

Hence a circle, center O , and radius R may be inscribed in the quadrilateral.

A solution was also offered by Hugo Brandt, Chicago; Howard Grossman, New York; B. Felix John, Philadelphia, Pa.

A CORRECTION

1855. Solve for x : $14(\sin \frac{1}{4} \arcsin x + \frac{1}{4} \arccos x) = 15$.

Hugo Brandt offers the solution given below. The solution offered in the April 1944 issue is not correct.

Let

$$\frac{1}{4} \arcsin x = a \text{ and } \frac{1}{4} \arccos x = b.$$

Then

$$\begin{aligned} x &= \sin 4a = \cos (90^\circ - 4a) \text{ and } x = \cos 4b \\ \therefore 4b &= 90^\circ - 4a \text{ and } b = 22\frac{1}{2}^\circ - a. \end{aligned} \quad (1)$$

The original equation becomes

$$14(\sin a + \cos b) = 15. \quad (2)$$

Using the value of b from (1), in (2),

$$14(\sin a + \cos 22\frac{1}{2}^\circ \cos a + \sin 22\frac{1}{2}^\circ \sin a) = 15.$$

Now

$$\cos 22\frac{1}{2}^\circ = .9239 \quad \text{and} \quad \sin 22\frac{1}{2}^\circ = .3827.$$

from which

$$14(1.3827 \sin a + .9239 \cos a) = 15.$$

By using

$$\sin a = \frac{\tan \alpha}{\sqrt{1 + \tan^2 \alpha}}, \quad \cos a = \frac{1}{1 + \tan^2 \alpha},$$

one obtains, with $t = \tan \alpha$,

$$14(1.3827t + .9239) = 15\sqrt{1+t^2}.$$

After some labor, one finds

$$t = .1115 = \tan \alpha,$$

from which

$$\begin{aligned} a &= 6.362^\circ, & b &= 16.138^\circ, \\ 4a &= 25.448^\circ, & 4b &= 64.552^\circ \end{aligned}$$

and

$$x = \sin 4a = \cos 4b = .42967.$$

A. E. Gault also solved this problem.

1873. *Proposed by Lillian A. MacDonald, Newark, N. J.*

Five times the sum of the ninth powers of the first n consecutive integers is divisible by the sum of the cubes of those numbers and the quotient is not a prime number.

Solution by PFC Roy E. Wild, Durham, N. H.

From a formula given by James Bernoulli for the sum of the r th powers of the first n integers, namely,

$${}_n S_r = \frac{n^{r+1}}{r+1} + \frac{n^r}{2} + \frac{r}{2!} B_1 n^{r-1} - \frac{r(r-1)(r-2)}{4!} B_2 n^{r-3} + \frac{r(r-1) \cdots (r-4)}{6!} B_3 n^{r-5} \dots$$

one obtains when $r=9$

$$\sum_1^n n^9 = \frac{n^{10}}{10} + \frac{n^9}{2} + \frac{3}{4} n^8 - \frac{7}{10} n^6 + \frac{1}{2} n^4 - \frac{3}{20} n^2.$$

Also

$$5 \sum_1^n n^9 = \frac{n^2}{4} (2n^8 + 10n^7 + 15n^6 - 14n^4 + 10n^2 - 3). \quad (1)$$

Also

$$\sum_1^n n^3 = \frac{n^2}{4} (n+1)^2. \quad (2)$$

Then

$$5 \sum_1^n n^9 / \sum_1^n n^3 = 2n^6 + 6n^5 + n^4 - 8n^3 + n^2 + 6n - 3$$

$$= (n^2 + n - 1)(2n^4 + 4n^3 - n^2 - 3n + 3).$$

A solution was also offered by Hugo Brandt, Chicago.

1874. *Proposed by Erma Johnson, Lewis, Pa.*

Solve for B and x

$$\frac{\sin B}{9} = \frac{\sin 2B}{15} = \frac{\sin 3B}{x}.$$

Solution by Cecil B. Read, Wichita, Kan.

Inspection reveals an obvious set of solutions: $B = 0 \pm 2n\pi$ with x any value except zero.

Replacing $\sin 2B$ by $2 \sin B \cos B$ and $\sin 3B$ by $3 \sin B - 4 \sin^3 B$ one can remove the common factor $\sin B$, corresponding to the obvious solutions just mentioned. The first two ratios yield $B = \arccos 5/6$ (an infinite number of values, terminating in the first or fourth quadrants. The corresponding value of $\sin B$ or $(\pm \sqrt{11}/6)$ yields $x = 16$.

Solutions were also offered by Morris Chernofsky, New York; Hugo Brandt, Chicago; W. W. Gorsline, Chicago; Lucy Pease, Interlaken, N. Y.; Joseph Lerner, New York; M. Kirk, West Chester, Pa.; W. R. Smith, Gainesville, Fla.; Julius Miller, New Orleans, La.; A. E. Gault, Peoria, Ill.; Helen M. Scott, Baltimore, Md.; Milton Schifffenbauer, New York; Elizabeth Kilcoyne, Buffalo, N. Y.; Walter R. Warne, Marshall, Mo.; Abbie Letts, Interlaken, N. Y.; Sigmund Chamer, New York; B. Felix John, Philadelphia, Pa.

1875. *Proposed by H. D. Grossman, New York City.*

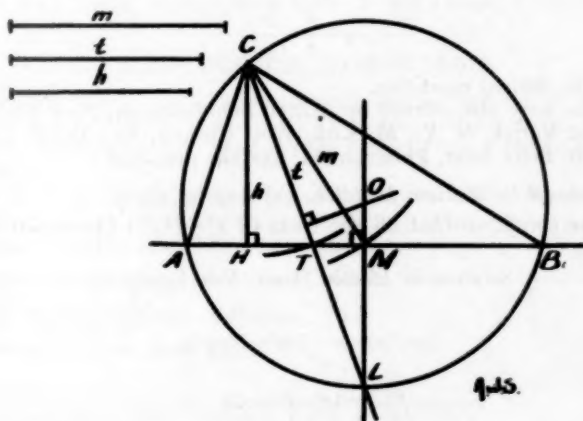
Construct a triangle, given the altitude, the median, and the angle bisector to one of the sides.

Solution by Alan W. Steinberg, 285 Lincoln Place, Brooklyn, N. Y.

Given: segment h equal the given altitude

segment m equal the given median

segment l equal the given bisector



Construction:

- (1) Draw line AB of indefinite length.

(2) At any point H erect a perpendicular to AB and lay off the segment HC equal to the given altitude h .

(3) Strike an arc from C equal to the bisector l and cutting AB at T . Draw CT and extend.

(4) Strike a second arc from C equal to the median m and cutting AB at M .

Note: Since each of the arcs in the last two steps will cut AB in two places, we will get four solutions, two sets of two identical triangles each. The case illustrated is the one in which both the bisector and the median fall on the same side of the altitude.

(5) Draw a perpendicular to AB at M and extend to meet CT at L .

(6) Draw the perpendicular bisector of CL and extend to meet ML at O .

(7) Using O as a center and OC or OL as a radius, scribe a circle cutting AB at points A and B .

ABC is the required triangle.

Solutions were also offered by: Sister Mary Paula, Baltimore, Md.; Margaret Joseph, Milwaukee, Wis.; M. Kirk, West Chester, Pa.; Elizabeth Kilcoyne, Buffalo, N. Y.; Hugo Brandt, Chicago.

1876. Proposed by W. R. Warne, Fayette, Mo.

Find the condition that the sum of two roots of $x^4 + px^3 + qx^2 + rx + s = 0$, shall be the sum of the other two roots.

Solution by Morris I. Chernofsky, New York City

Suppose the four roots of the given equation to be a, b, c, d . According to the conditions of the problem, $a + b = c + d$. Then,

$$a + b + c + d = 2(a + b) = -p \quad \text{whence} \quad (a + b) = -\frac{p}{2} \quad (1)$$

$$ab + ac + ad + bc + bd + cd = ab + cd + \frac{p^2}{4} = q, \quad \text{whence} \quad ab + cd = q - \frac{p^2}{4} \quad (2)$$

$$abc + abd + acd + bcd = (ab + cd) \left(-\frac{p}{2} \right) = -r, \quad \text{whence} \quad ab + cd = \frac{2r}{p}. \quad (3)$$

Combining, then, (2) and (3), we get

$$q - \frac{p^2}{4} = \frac{2r}{p},$$

which is the desired condition.

Solutions were also offered by Milton Schiffenbauer, New York; Jean Dean, East Varick, N. Y.; M. Kirk, West Chester, Pa.; W. W. Gorsline, Chicago; B. Felix John, Philadelphia; and the proposer.

1877. Proposed by William Meddick, Los Angeles, Calif.

Find the condition that all the roots of $x^4 - 14x^2 + 24x - k = 0$ shall be real.

Solution by Martin Davis, New York City

Let

$$y = f(x) = x^4 - 14x^2 + 24x - k.$$

Then

$$f'(x) = 4x^3 - 28x + 24.$$

Also

$$f''(x) = 12x^2 - 28.$$

To determine critical values put $f'(x)=0$. The roots are 1, 2, -3.

Since $f''(1) = -16$, $f''(2) = 20$, $f''(-3) = 80$, the minimum values of $f(x)$ are $(2, 8-k)$ and $(-3, -k-117)$. A maximum value is $(1, 11-k)$.

A condition for 4 real and different roots is: $8 < k < 11$. If $k=11$ or 8, then in each case 2 roots are equal.

Solutions were also offered by M. Kirk, West Chester, Pa.; Hugo Brandt, Chicago; Milton Schiftenbauer, New York; W. W. Gorsline, Chicago.

1878. *Proposed by Phillip S. Perkins, Camden, N. J.*

Prove that $7^{2n} - 48n - 1$ is divisible by 2304.

Solution by Albino Webber, Amasa, Mich.

7^2 may be written 49, or $(48+1)$, and therefore, 7^{2n} may be written $(48+1)^n$.

And 2304 may be written $(48)^2$.

Rewriting the problem

Prove that $(48+1)^n - 48n - 1$ is divisible by 48^2 .

For any value of n , the last two terms of the expansion $(48+1)^n$ would equal $48n+1$.

And therefore, $(48+1)^n - 48n - 1$ would leave an expression in which each term would contain 48 raised to the second power or above, and hence, divisible by 48^2 or 2304.

Example;

If n equals 5, then $(48+1)^n - 48n - 1$ would equal

$$48^5 + 5(48)^4 + 10(48)^3 + 10(48)^2 + 5(48) + 1 - 48(5) - 1.$$

By combining like terms, the last four terms drop out, leaving the preceding terms divisible by 48^2 or 2304.

Conclusion

$7^{2n} - 48n - 1$ is divisible by 2304.

Solutions were also offered by Mildred Hopkins, Mitchell, Ind.; PFC Roy E. Wild, Durham, N. H.; Hugo Brandt, Chicago; M. Kirk, West Chester, Pa.; Joseph Herner, New York; B. Felix John, Philadelphia, Pa.

HIGH SCHOOL HONOR ROLL

The Editor will be very happy to make special mention of high school classes, clubs, or individual students who offer solutions to problems submitted in this department. Teachers are urged to report to the Editor such solutions.

Editor's Note: For a time each high school contributor will receive a copy of the magazine in which the student's name appears.

For this issue the Honor Roll appears below.

1874. Benjamin Sedlky, Montreal, Canada; Osias Bain, Quebec, Canada.

1875. B. Sturton, Quebec, Canada.

1877. Martin Davis, New York.

PROBLEMS FOR SOLUTION

1891. *Proposed by Orlando Kelley, Romulus, N. Y.*

Solve for x :

$$\begin{vmatrix} x^2-a^2 & x^2-b^2 & x^2-c^2 \\ (x-a)^2 & (x-b)^2 & (x-c)^2 \\ (x+a)^2 & (x+b)^2 & (x+c)^2 \end{vmatrix} = 0.$$

1892. *Proposed by Orlando Kelley, Romulus, N. Y.*

Find to infinity the sum:

$$\frac{1}{3} + \frac{1 \cdot 3}{3 \cdot 6} + \frac{1 \cdot 3 \cdot 5}{3 \cdot 6 \cdot 9} + \dots$$

1893. *Proposed by Rita Dorner, Syracuse, N. Y.*

Solve $3x^3 - 32x^2 + 33x + 108 = 0$, if one root is the square of another.

1894. *Proposed by William O. Stoddard, Millersville, Pa.*

If a_1, a_2, a_3 are roots of $x^3 + px + q = 0$, find

$$\sum \frac{1}{a_1^2 + a_2 a_3}.$$

1895. *Proposed by J. S. Miller, New Orleans, La.*

Solve for x : $k(x^4 + 1) = (x + 1)^4$.

1896. *Proposed by Danial Finkel, Washington, D. C.*

An examination consists of four papers with a maximum of m marks for each paper. What is the number of ways of getting $2m$ marks on the examination?

BOOKS AND PAMPHLETS RECEIVED

THE PHILOSOPHY OF BERTRAND RUSSELL, edited by Paul Arthur Schilpp, *Northwestern University*. Cloth. Pages xvi + 815. 15 × 23 cm. 1944. 101 Fayetteweather Hall, East, Northwestern University, Evanston, Ill. Price \$4.00.

MATHEMATICS FOR AIRCRAFT ENGINE MECHANICS, by Harold Griffiths, *Instructor, Brazilian Division, Embry-Biddle School of Aviation, Miami, Florida: Formerly Instructor at the Pennsylvania State School of Aeronautics, Harrisburg, Pa.* Cloth. Pages xv + 367. 13 × 21 cm. 1944. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York, N. Y. Price \$2.50.

ELECTRONICS; TODAY AND TOMORROW, by John Mills, *Sometime Member Technical Staff, Bell Telephone Laboratories*. Cloth. 178 pages. 13 × 19.5 cm. 1944. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y. Price \$2.25.

MAN AND HIS BIOLOGICAL WORLD, by Frank Covert Jean, Ezra Clarence Harrah, and Fred Louis Herman, *Colorado State College of Education* with the Editorial Collaboration of Samuel Ralph Powers, *Teachers College, Columbia University*. Cloth. Pages vi + 631. 15.5 × 22.5 cm. 1944. Ginn and Company, Statler Office Building, Park Square, Boston, Mass. Price \$3.50.

BEHAVIOR CHANGES RESULTING FROM A STUDY OF COMMUNICABLE DISEASES, by John Urban, Ph.D., *Teachers College, Columbia University*. Contributions to Education, No. 896. Cloth. Pages viii + 110. 15 × 23 cm. 1943. Bureau of Publications, Teachers College, Columbia University, New York, N. Y. Price \$1.85.

HACKH'S CHEMICAL DICTIONARY, Third Edition Completely Revised and Edited by Julius Grant, M.Sc., Ph.D., F.R.I.C. Cloth. Pages xii + 925. 16.5 × 24.5 cm. 1944. The Blakiston Company, 1012 Walnut Street, Philadelphia, Pa. Price \$12.00.

AIR NAVIGATION MADE EASY, by James Naidich, *Chairman, Department of Mathematics, Manhattan High School of Aviation Trades; C.A.A. Certified Ground School Instructor in Air Navigation*, with the Editorial Assistance of Harry Schor, *Chief Instructor, C.A.A. Ground School, Polytechnic Institute of Brooklyn*. Cloth. Pages ix + 124. 18.5 × 25.5 cm. 1944. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York, N. Y. Price \$1.75.

PHYSICS OF THE 20TH CENTURY, by Pascual Jordan and Translated by Eleanor Oshry. Cloth. Pages xii + 185. 13.5 × 21.5 cm. 1944. The Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. Price \$4.00.

RADIO: FUNDAMENTAL PRINCIPLES AND PRACTICES, by Francis E. Alstead, *Lieutenant, U.S.N.R., Bureau of Naval Personnel, Washington, D. C.*; Kirke E. Davis, *Head, Science Department, Oceanside High School, Oceanside, N. Y.*; and George K. Stone, *Senior Education Supervisor, The State Education Department, Albany*. Cloth. Pages vii + 219. 13 × 20 cm. 1944. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York, N. Y. Price \$1.80.

A NEW MANUAL FOR THE BIOLOGY LABORATORY, by Bernal R. Weimer, *Professor of Biology, Bethany College, West Virginia*, and Earl L. Core, *Professor of Botany, West Virginia University*. Paper. Pages vii + 213. 21 × 28 cm. 1944. John Wiley and Sons, Inc., 601 W. 26th Street, New York, N. Y. Price \$2.00.

BULLETIN, GEORGE PEABODY COLLEGE FOR TEACHERS. 125 pages. 15 × 23 cm. 1944. George Peabody College for Teachers, Nashville 4, Tenn. Price 25 cents.

FOURIER SERIES, by G. H. Hardy and W. W. Rogosinski. Paper. 100 pages. 14 × 21 cm. 1944. The Macmillan Company, 60 Fifth Avenue, New York, N. Y. Price \$1.75.

DIRECTING VOCATIONAL AGRICULTURE DAY-SCHOOL STUDENTS IN DEVELOPING THEIR FARMING PROGRAMS, by W. A. Ross, D. M. Clements, and E. J. Johnson. Paper. Pages iv + 72. 15 × 23.5 cm. 1944. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 15 cents.

HUNDRED-PROBLEM ARITHMETIC TEST—WHOLE NUMBERS, COMMON FRACTIONS, DECIMAL FRACTIONS, PER CENTS, by Raleigh Schorling, *Head of Department of Mathematics, the University High School*, and *Professor of Education, University of Michigan*; John R. Clark, *The Lincoln School, Teachers College, Columbia University*; and Mary A. Potter, *Supervisor of Mathematics, Public Schools, Racine, Wisconsin*. Form W, 12 pages, is put up in packages of 25 tests, with Manual of Directions, Key, and Class Record. Price per Package, net 90 cents. World Book Company, Yonkers-on-Hudson 5, New York, N. Y.

TEST OF FUNCTIONAL THINKING IN MATHEMATICS, by Judson W. Foust, *Central Michigan College of Education, Mt. Pleasant, Michigan*, and Raleigh Schorling, *University of Michigan, Ann Arbor, Michigan*. Form B, 6 pages,

is put up in package of 25 tests, with Manual of Directions, Key, and Class Record. Price per Package, net \$1.25. World Book Company, Yonkers-on-Hudson 5, New York, N. Y.

BOOK REVIEWS

ELECTRONICS: TODAY AND TOMORROW, by John Mills, *Sometime Member Technical Staff Bell Telephone Laboratories*. Cloth. 178 pages. 13×19.5 cm. 1944. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y. Price \$2.25.

Here is a book by a master, written to bring a new subject to the reader who has made no specific preparation for it but who has a good general scientific education and a desire to know about the subject. It is a little book but it covers a great field. To discuss a topic of this type without the use of either a drawing or a mathematical equation requires the mind of a specialist; to follow the discussion and understand it completely requires the ability of a genius, unless he has previously acquired a fair knowledge of many of the elements of physics. In his masterly style the author starts with easily acquired ideas and gradually builds up his explanation. The book consists of a short introduction, which gives the fundamental ideas of electricity; a major section on Electron Tubes, starting with the original discovery of Edison and its first use by Fleming, then carrying the explanation through the use and action of the modern tubes of all types; a second major section of Electronic Devices such as those used in television, electron optics and photography, ultrahigh frequencies and their generators, and cyclotrons.

The book is a masterpiece of discussion and explanation, but it requires considerable visualization and no doubt much past experience with electrical apparatus and thought to enable the student to grasp all the ideas presented. The topic is so enthralling and so wonderfully told to those who have some knowledge of the field that one wonders if it would not have been much better had the book been filled with diagrams and pictures to assist those with less past experience.

G. W. W.

GENERAL PHYSICS, A TEXTBOOK FOR COLLEGES, by Oswald Blackwood, Ph.D., *Professor of Physics, The University of Pittsburgh*. Cloth. Page viii+622. 13.5×21.5 cm. 1943. John Wiley and Sons, Inc., 440 4th Avenue, New York, N. Y. Price \$3.75.

This book is an enlargement and revision of the author's previous text, *Introductory College Physics*, which appeared in 1939. It contains much of the original book just as it appeared but many improvements have been made and additional material interwoven. In the new edition, following the introductory chapter on Science and Measurement, the author has placed the chapter on Work, Power, and Machines, and the one on Friction before those on Forces in Equilibrium and Levers and Torques, as in the previous book. This with the addition of about twenty pages of additional material on various sections constitutes the main changes in the revised section on Mechanics. The problems at the end of each chapter are now grouped into three sections of increasing difficulty. In the second division, Molecular Physics and Heat, the new text contains a few pages more than the original book but the material of the first three chapters in the old book now appears in one chapter. Throughout this section the changes consist more in the revision of the former text than in writing a new one. In general we may say that the most important changes made in these sections,

which frequently cover the work of one semester, consist of some rearrangement of topics, a few changes in discussion, and in the addition of about 10%.

But in the remainder of the book there is a different story. The discussion of sound is increased almost 50%, light about 35%, electricity and magnetism 60%, and the section on the New Physics 80%. In sound there are additional topics on sound ranging, architectural acoustics, and hearing; also improvements in the discussion of music. In light the change is not so pronounced but numerous new illustrations appear and the text has been amplified and new material added. In the chapter on electricity and magnetism much of the text is entirely new and greatly improved. The principal exception is the chapter on electrolysis and voltaic cells, which has been repeated with only minor changes. A new chapter on alternating current theory has been added and the chapter on radio improved. The section on the New Physics has been brought up to date and greatly enlarged. In addition to the changes in the text new lists of problems and questions have been provided for each chapter and two or three good reading references. The text in its new form has eliminated most of the objections raised against its predecessor and should now have wide adoption.

G. W. W.

ESSENTIALS OF ASTRONOMY, by John Charles Duncan, Ph.D., *Professor of Astronomy in Wellesley College*. Cloth. Pages vii+181. 14×21.5 cm. 1942. Harper and Brothers, 49 East 33rd Street, New York, N. Y. Price \$1.85.

This is a book for the short course in astronomy; for students who have a very limited time to devote to the subject, and who have made almost no preparation for it, such as courses in mathematics and physics give. Starting with a view of the sky as it appears to the ordinary observer the author points out a few of the constellations, describes the celestial sphere, and tells how celestial measurements are made. The general appearances are next interpreted, longitude and time are explained, and the solar system briefly described. Gravitation and the laws of motion are briefly explained and the most important ideas of light and of light instruments are discussed. The latter half of the book consists of an excellent chapter on the solar system, a chapter on the stars with a description of the sun as representing one type, and a short chapter on other galaxies. The book also contains fourteen appendices and eight star maps. In using this book the class should have considerable library help and much assistance from the instructor. It is an excellent guide for short-term courses.

G. W. W.

BASIC AIR NAVIGATION, by Elbert F. Blackburn, *Chief Navigation Instructor, Atlantic Division, Pan American Airways System*. Cloth. Pages vii+300. 14×22.5 cm. 1944. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, N. Y. Price \$3.00.

During the past three or four years many books have appeared to assist in the training of air pilots. A few of these have been excellent, some mediocre, and some practically worthless. This one certainly belongs in the first group. Although the author says, "Basically, navigation is simple, and I have done my best to keep it so," many of the flight students now entering the field will not agree. Present conditions demand that many young men select their courses without very serious thought of what is required. Here a good high school course is prerequisite, with three or more years of mathematics and physics. The basic problems of the navigator require

the use of vector diagrams and solutions. If the secondary school does not provide sufficient work in this field, a college course is imperative. This text provides excellent explanations, diagrams, and charts, but considerable work must be done by the student if he masters them. A double page reproduction of the U. S. Coast and Geodetic Survey Chart 3060 is used repeatedly but the map is entirely too small for efficient study. Excellent chapters on the instruments of flight, radio aids, and lines of position are included. The chapters on the principles and practice of celestial navigation will require many hours study of the night skies and much practice with the use of the navigation tables. An envelope of cutout computing models and chart problems is included. The book contains the basic material for a thorough course in air navigation. It will require, however, a considerable amount of time and additional exercise material for a complete mastery of the subject by the average student.

G. W. W.

HOW TO PASS RADIO LICENSE EXAMINATIONS, by Charles E. Drew. Second Edition. Cloth. 320 pages. 16.5×24 cm. 1944. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. Price \$3.00.

This is a book of questions and answers to assist the student in passing the radio examinations of the Federal Communication Commission. The topics covered are (1) Radio Laws, (2) Basic Theory and Practice, (3) Radiotelephone, (4) Advanced Radiotelephone, (5) Radiotelegraph, and (6) Advanced Radiotelegraphy. Each topic lists many questions and gives complete answers, using diagrams wherever needed. Students preparing for these examinations will find this book a great help. The author has given many of the answers in detail so that the book gives an excellent discussion of some of the more difficult topics such as modulation, impedence, oscillators, the use of quartz crystals, classes of amplifiers, microphone types, rectifier power supplies, etc. The International Morse Code, A Table of Abbreviations, extracts from radio laws and other important data are given in the Appendix. This book is excellent for students preparing for radio.

G. W. W.

INTRODUCTORY ASTRONOMY, A GUIDE FOR NIGHT WATCHERS, by J. B. Sidgwick, *Member of the Société Astronomique de France and of the British Astronomical Association*. Cloth. Pages viii+137. 14.5×23 cm. 1944. Philosophical Library, Inc., 15 East 40th Street, New York, N. Y. Price \$2.50.

This book is just what the title indicates—an introductory text for the study of astronomy. It consists of about sixty pages of descriptive and explanatory material on the skies, telling about what can be seen with the eyes alone or by the use of a pair of binoculars. Most attention is given to the moon and the planets, with short chapters on the Stars and the Galaxy, Star Clusters and Nebulae. The latter half of the book consists of tables and star charts to assist the student in becoming familiar with the skies. The book is a good aid for individual study but is not suitable as a textbook for most elementary classes as they must operate.

G. W. W.

PLANE AND SPHERICAL TRIGONOMETRY, by Donald H. Ballou, Ph.D., *Assistant Professor of Mathematics, Middlebury College*, and Frederick, H. Steen, Ph.D., *Associate Professor of Mathematics, Allegheny College*. Cloth. Pages vi+179+10. 14.5×22.5 cm. 1943. Ginn and Company, Statler Building, Boston, Mass. Price \$2.20.

This book has been written for college and engineering school courses in trigonometry. Hence, the material has been prepared to meet the needs of students preparing for work in advanced mathematics, physics, engineering, navigation and other sciences.

The general angle definitions of the trigonometric functions have been given first in order to emphasize the general nature of the functions. The book contains a large number of carefully graded written exercises. In addition numerous sets of oral exercises are presented for the purpose of providing rapid drill in reviewing previous work done. Since the authors state that the aim has been to present the fundamentals of trigonometry as directly and concisely as possible, they have omitted certain topics such as graphs, complex numbers and series. In the spherical trigonometry the use of haversines is explained, and the haversine formulas are extensively employed in solving the problems of great-circle sailing and celestial navigation.

The text contains many practical applications and a number of excellent illustrations. The figures are well drawn and the pages are not crowded. This book should be of interest to teachers in technical schools and to those preparing students for advanced mathematics and engineering courses.

C. A. STONE

HOW TO PASS A WRITTEN EXAMINATION, by Harry C. McKown, *Author, Lecturer, Editor, School Activities*. Cloth. Pages xi + 162. 13.5 × 20.5 cm. 1943. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York, N. Y. Price \$1.50.

This is an excellent book for those students or adults who are taking written examinations. The author opens his discussion by explaining the purposes of written examinations. He then tells the reader how to prepare for them emotionally, physically and mentally. This is followed by a chapter giving general suggestions on taking examinations. The next two chapters tell how to answer both objective and essay type examinations. The last chapter deals with the topic of what to do after examinations have been completed.

The book is written in a very interesting style and offers a large number of definite suggestions, nearly all of which are illustrated by actual examination questions, settings or conditions. A list of selected references on how to study is also included. The reviewer recommends this book as an addition to the students' library.

C. A. STONE

MILITARY APPLICATIONS OF MATHEMATICS, by Paul P. Hanson, M.A., *Lieutenant, United States Army (Retired); Instructor in Mathematics, The Manlius School, Manlius, New York*. Cloth. Pages xiii + 447. 14 × 22.5 cm. 1944. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York, N. Y. Price \$2.40.

This is an exceptionally good collection of military applications of mathematics, the mathematics involved being in general of secondary school level. The author has used many sources in an effort to include in a single volume material which otherwise could only be found in widely scattered sources. He has also pointed out the fact that changes in methods take place rapidly; his suggestions for additional material would yield clues to the location of the most recent information. Illustrative of the material included in the text are military maps, tables of natural and logarithmic functions in mils, and an abridged form of HO 211 (the Agerton table for celestial navigation).

The scope of the material covered may be indicated by chapter headings: Military maps (48 pages); field-artillery gunnery (76 pages); air navigation (118 pages); miscellaneous applications, including seacoast artillery gunnery, range finders, bomb ballistics, antiaircraft gunnery, motor transport, practical military engineering (53 pages). The appendix is a mathematics refresher through trigonometry, with some elementary discussion of probability and a section on the slide rule. There is an ample supply of exercises, with tables required to solve the problems included in the appendix.

The treatment is unusually complete, even if a course covering the subject matter of the text is not contemplated, the material found in one book is more extensive than in half a dozen other references.

The reviewer is not competent to criticize some of the technical material, with respect to the mathematical treatment, only one point was noted—the author would state there are four significant figures in 3.0450, many authorities would claim this number has five significant digits.

CECIL B. READ
University of Wichita

CALCULUS REFRESHER FOR TECHNICAL MEN, by Albert Klaf, B.S., M.E., *Civil Engineer, Board of Water Supply, City of New York*. Cloth. Pages viii+431. 13×21 cm. 1944. Whittlesey House, McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 18, N. Y. Price \$3.00.

A unique feature is the method of presentation—by means of questions and answers, 756 questions. Of these, a large portion are solved examples. The primary object is definitely a 'refresher'—although the publishers claim it is fully adequate for one just beginning the subject most teachers will question the latter statement. For example, many formulas of differentiation are presented with no proof whatsoever. (The derivatives of the trigonometric functions are a good example of this method.) Some of the terminology departs from customary mathematical usage, for example: 'a sudden cusp'; 'a point of inflection is . . . where the curve is a bit of a straight line.'

Perhaps for the teacher the greatest value of the book would be the third section—applications of calculus, over fifty worked examples, several of which are not customarily found in elementary calculus texts. For the student, the many worked examples throughout the book would be of value in reviewing the subject.

An appendix contains useful formulas from algebra and trigonometry (but not analytic geometry), collected formulas from the text itself, a table of 201 integrals, four place tables of logarithms and of natural and logarithmic trigonometric functions, and a very brief table of natural logarithms. There are answers to most of the problems—then number of problems is probably inadequate for use as a college text.

CECIL B. READ

MATHEMATICS FOR AIRCRAFT ENGINE MECHANICS, by Harold Griffiths, *Instructor, Brazilian Division, Embry-Riddle School of Aviation, Miami, Florida; Formerly Instructor at the Pennsylvania State School of Aeronautics, Harrisburg, Pennsylvania*. First Edition. Cloth. Pages xv+367. 14×21.5 cm. 1944. McGraw-Hill Book Company, Inc., New York 18, N. Y. Price \$2.50.

In this text the author presents, primarily by means of over 2,000 problems based on actual data, mathematics as an important tool of the aviation mechanic. The field covered is deliverately narrow—the text would

probably not be suitable in a general vocational course, but would be excellent reference material for any mathematics teacher.

Part I, 52 pages, reviews the fundamentals of arithmetic; Part II, 60 pages, deals with the functioning of the engine; Part III, 110 pages, deals with repair and testing of engines, with considerable material on measuring instruments; Part IV, 33 pages, covers valve and ignition timing; Part V, 65 pages, deals with the repair of some of the engine accessories. The appendix summarizes formulas, conversion factors, lists abbreviations, and gives a few selected references, including films and film strips, a glossary is included. Answers are given for the even numbered problems, a note states that complete answers are available.

CECIL B. READ

ESSENTIALS OF BUSINESS ARITHMETIC, Revised Edition, by Edward M. Kanzer, *James Monroe High School, New York City, and Teachers College*; and William L. Schaaf, *Assistant Professor of Education, Brooklyn College*. Cloth. Pp. viii+476; 13.5×20 cm. D. C. Heath & Company, 285 Columbus Ave., Boston. 1943. Price \$1.48.

This book is written to appeal to the learner's interest. Instead of starting with the usual often-times boring review of fundamental processes, a sequence of topics based upon realistic considerations has been followed. Thus, before a business can be carried on, there must be ownership; before there can be sales, purchases must be made, and so on. Hence, the order of topics followed is proprietorship, purchases, sales profit and loss, determining selling price, elements of factory cost, pay rolls, simple interest, bank discount, cost of real property, real estate taxes, fire insurance, repairs and improvements, fundamental processes, office problems, personal and business problems, agricultural and business organization problems. In this revised edition, additional subject matter includes material on credit unions, farm problems, co-operative markets, FHA loans, social security, business machines and other timely topics. Preliminary drills, reviews and cumulative reviews abound. Daily lesson units and assignments differentiated on three levels are provided. Although planned especially for a full year course of study, a brief edition which can be covered in one semester is also available.

GLENN HEWITT,
Von Steuben High School, Chicago

MATHEMATICS FOR THE EMERGENCY, a text-workbook in essential mathematics. By C. J. Lapp, *Associate Professor of Physics at the University of Iowa, now on leave of absence and serving as Head of the Department of Mathematics and Physics of the Navy Pre-Flight School (Iowa)*; F. B. Knight, *Director of the Division of Education and Applied Psychology, Purdue University*; and H. L. Rietz, *Professor of Mathematics at the University of Iowa*. Paper. 158 pp.; 20×28 cm.; 1942; 80¢. A revision of *Review of Pre-College Mathematics*. Scott, Foresman and Company, 623 S. Wabash Ave., Chicago.

This combination text and workbook is designed for students who have studied advanced mathematics but need a review before graduating or entering the armed forces or industry. With sets of regular texts at hand for occasional reference, the workbook is self sufficient. It provides explanations of, and drill in, the fundamentals of arithmetic, geometry and trigonometry, with the major emphasis on algebra. Numerous problems of wartime significance are provided. The material was determined by first-hand experience with students, analysis of the requirements of advanced

work and research on frequency of errors among students. Answers to the odd-numbered problems are included, perforated to make removal possible.

GLENN HEWITT

LIBERAL EDUCATION, by Mark Van Doren. Cloth. Pages xi + 186. 13.5 × 21 cm. 1943. Henry Holt and Company, 257 Fourth Avenue, New York, N. Y. Price \$2.50.

Mr. Van Doren's recent book on liberal education is probably one of the soundest expressions of the basic problems confronting education and the preservation of modern culture at the present time. It is an extremely difficult book to review because it is so very quotable. The author ties up and states quite clearly the relation existing between democracy and education.

"It has been said that the question is not what education can do for democracy, but what democracy can do for education. If democracy is not strong enough to deserve the compliment implied, it is not strong enough to teach. Democracy as educator is man teaching. It serves itself by making its problems free. This is another way of saying that it serves itself by making men. So education is democracy, and democracy is education. The statesman is the teacher, and the teacher is the statesman. There is no such thing as education for democracy. Education is either good or bad. The best education makes the best men; and they will be none too good for democracy. Democracy cannot survive a loss of faith that the best man will make the best citizen. It certainly cannot afford to educate men for citizenship, for efficiency, or for use."

In another place the author develops the same theme with the startling declaration that "democracy wants millions of one-man revolutions" and again "the only common good is that which is common to good men."

Through the essay, Van Doren stresses the necessity of developing the intellectual powers of the student. Commenting on an expression that "American youth be taught how to think internationally" Van Doren replies, "It would be still better to teach them how to think. Democracy depends for its life upon the chance that every man will make all the judgments he can."

There is a marked similarity between *Liberal Education* and Newman's classic, *Idea of the University*. Both find the best summation of his thoughts on the subject in an earlier writer (Milton—*On Education*) who says, "I call, therefore, a complete and generous education that which fits a man to perform justly, skilfully, and magnanimously, all the offices, both private and public, of peace and war." Further, both Newman and Van Doren are agreed that education, liberal or otherwise, is primarily of the intellect. "The conscious business of education," says the latter, "is with the intellect. . . . The arts of the intellect, as distinguished from its virtues can be taught; and the traditional duty of the college is to teach them." Liberal education, he says further on must pay some attention to the skills of doing, but "The prime obligation of liberal education is with the skills of being." Van Doren expresses a profound truth when he states that the problem of the liberal arts curriculum is an operational one. "Some studies are surely secondary to others . . . this question should be made manifest and those students should be permitted to ignore the primary, the basic matter." "Philosophy is the first need everywhere."

It is this reviewer's opinion that all those concerned with higher education in the United States read thoroughly and give serious consideration to the suggestions and proposals of Mark Van Doren. It would seem that he has pointed the way, as others have before him, to a desirable reorientation of education in these United States.

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